US005867470A

United States Patent [19]

Kim et al.

[11] **Patent Number: 5,867,470**

[45] **Date of Patent: *Feb. 2, 1999**

[54] **DISK RECORDING/REPRODUCING APPARATUS HAVING TWO TRAYS SO THAT A DISK IN A MAGAZINE CAN BE REPLACED BY ONE TRAY WHEN A DISK IN THE OTHER TRAY IS BEING RECORDED/REPRODUCED**

[75] Inventors: **Young-Taek Kim**, Suwon; **Cheol-Woong Ahn**, Seoul, both of Rep. of Korea

[73] Assignee: **Samsung Electronics Co., Ltd.**, Kyungki-do, Rep. of Korea

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,715,229.

[21] Appl. No.: **685,915**

[22] Filed: **Jul. 22, 1996**

[30] **Foreign Application Priority Data**

Oct. 31, 1995 [KR] Rep. of Korea 1995 39051

[51] **Int. Cl.**[6] **G11B 17/04**; G11B 17/10; G11B 33/04

[52] **U.S. Cl.** **369/178**; 369/75.2; 369/192

[58] **Field of Search** 369/75.1, 75.2, 369/77.1, 77.2, 36, 178, 192; 360/92, 94, 98.01, 98.04

[56] **References Cited**

U.S. PATENT DOCUMENTS

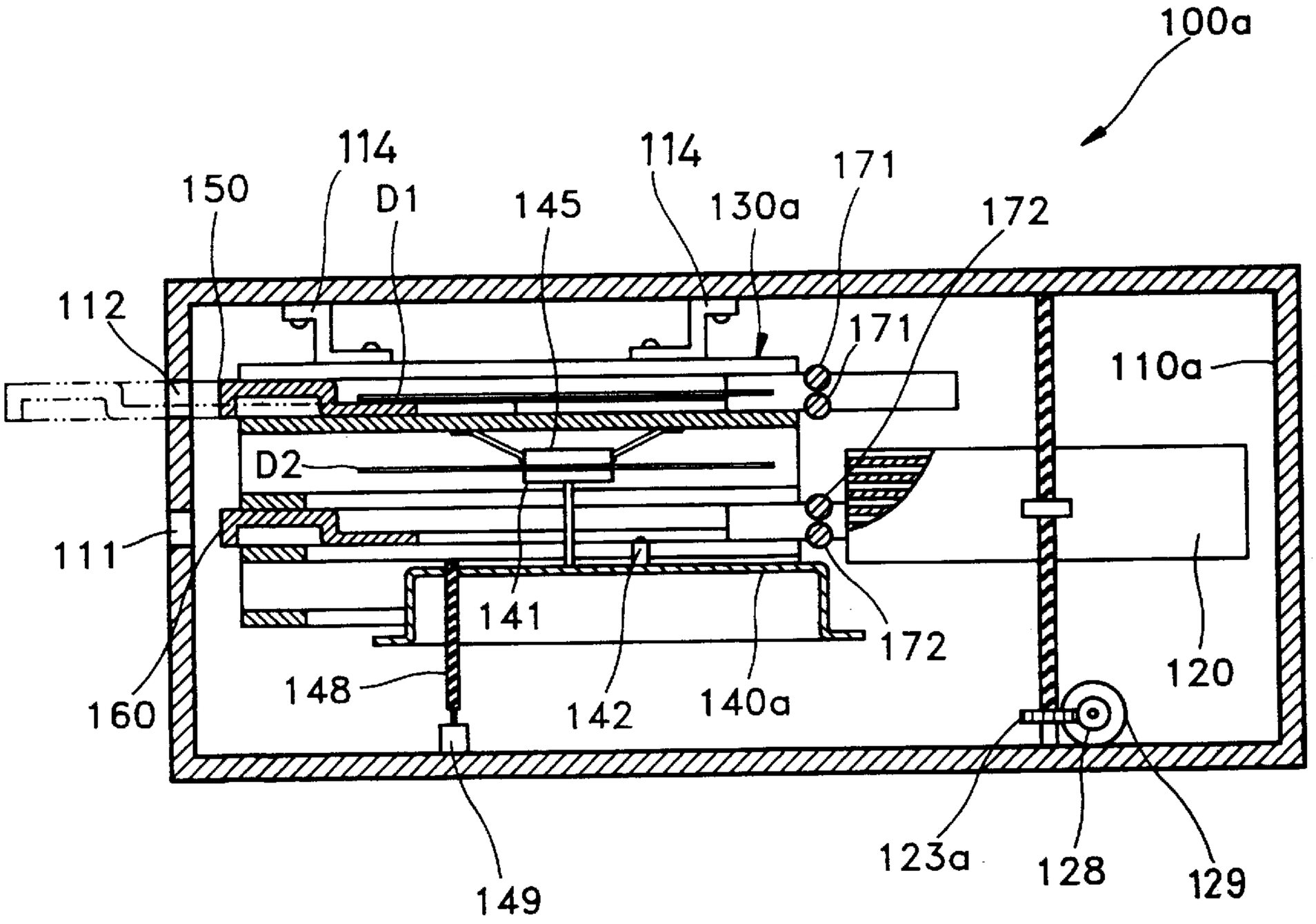
4,949,328	8/1990	Kase et al.	369/75.2
5,146,446	9/1992	Ota et al.	369/77.2
5,226,032	7/1993	Ikedo et al.	369/178
5,327,412	7/1994	Lee	369/178
5,384,760	1/1995	Kumakura	369/38
5,615,197	3/1997	Choi	369/77.2

Primary Examiner—George J. Letscher
Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas, PLLC

[57] **ABSTRACT**

A disk recording/reproducing apparatus includes a stacked pair of trays each having a disk seating unit thereon and a magazine containing a plurality of disks. While a disk seated in one tray is being recorded on or reproduced from, a disk within a magazine can be removed and replaced by the other tray.

6 Claims, 19 Drawing Sheets



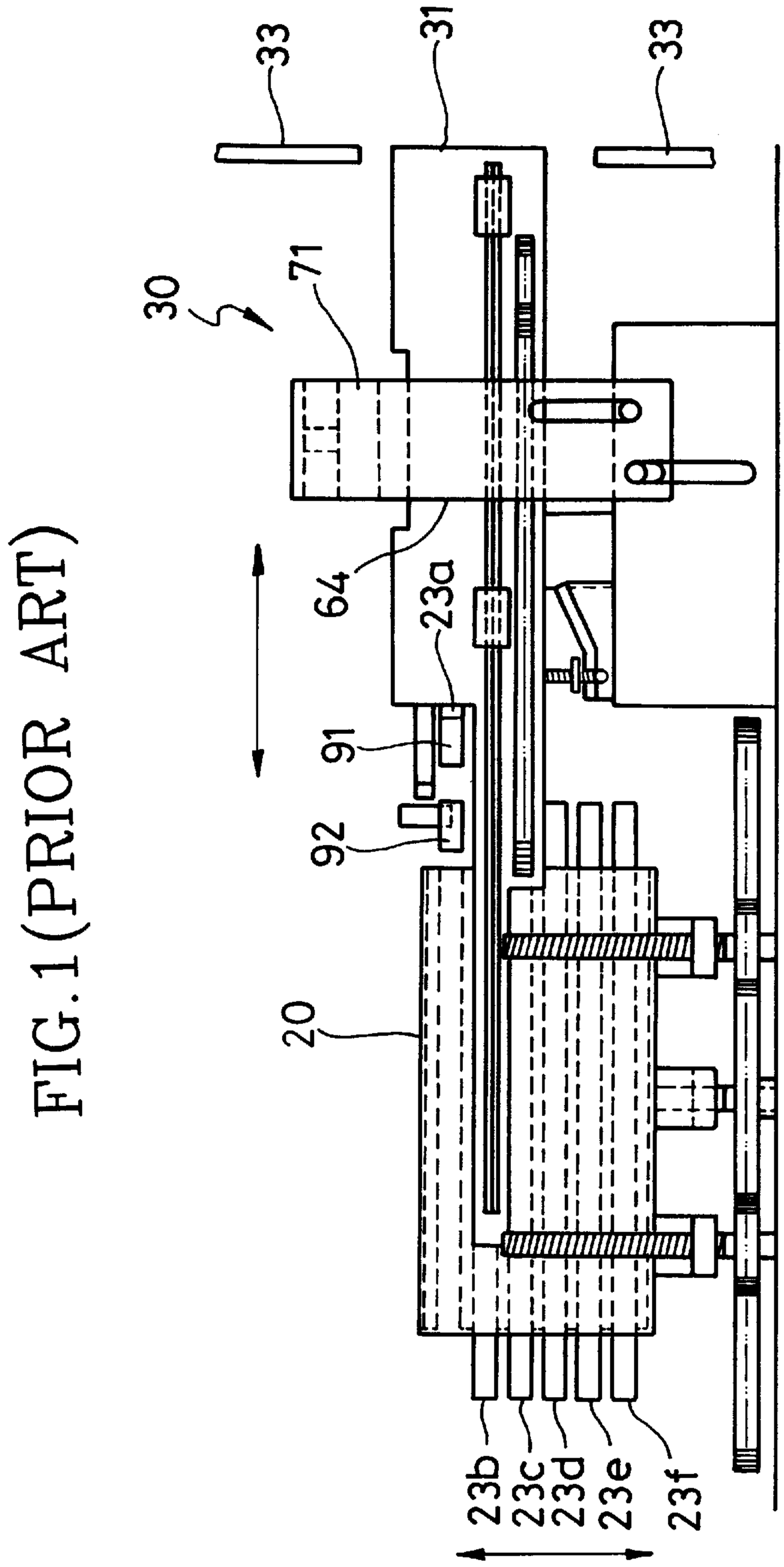


FIG. 1 (PRIOR ART)

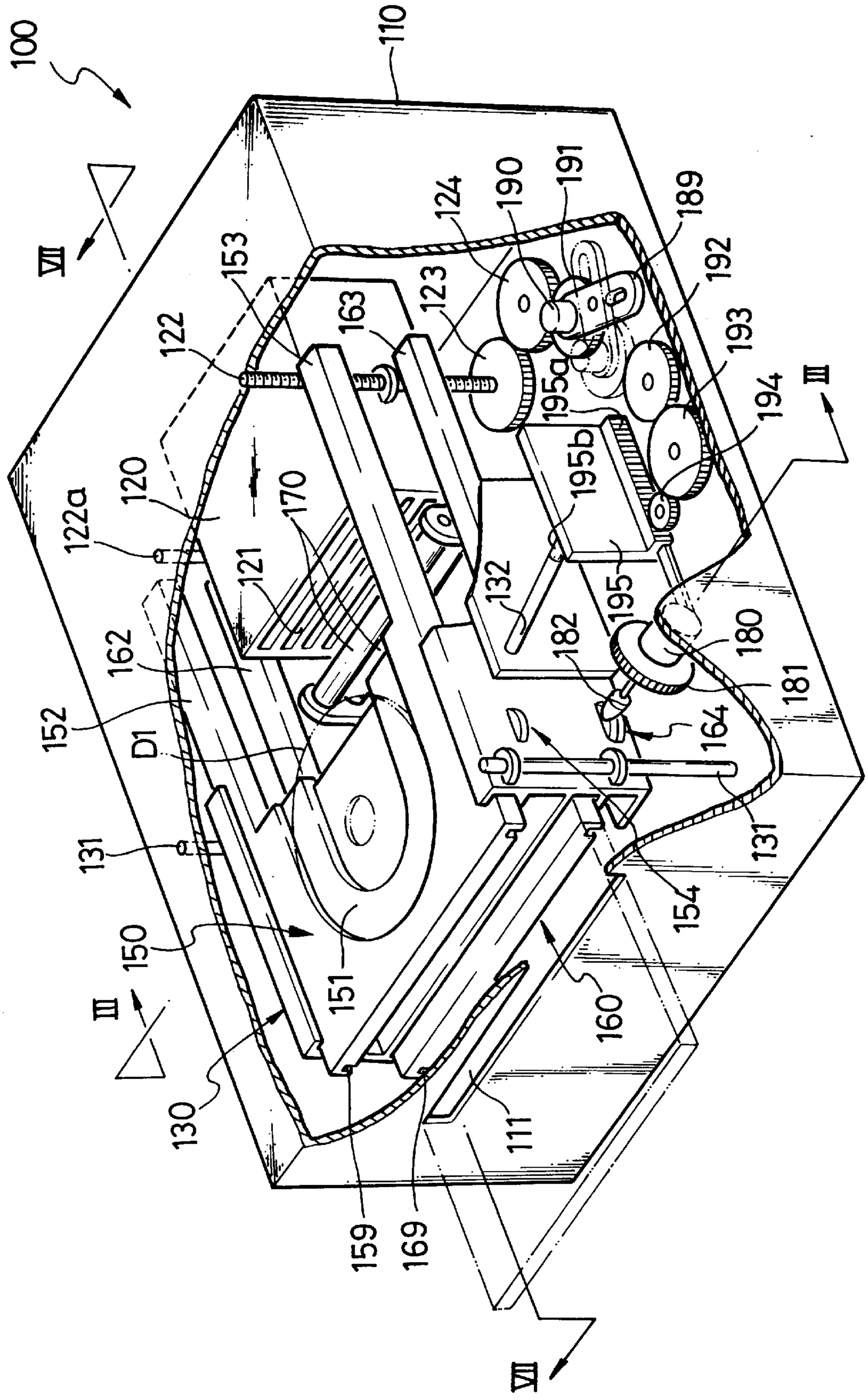

100
110
VII
153
122
163
123
124
190
191
189
192
193
194
III
195a
195b
120
122a
170
121
132
195
182
180
181
164
162
152
D1
131
150
II
151
154
160
130
111
159
169
VII

FIG.2

FIG.3

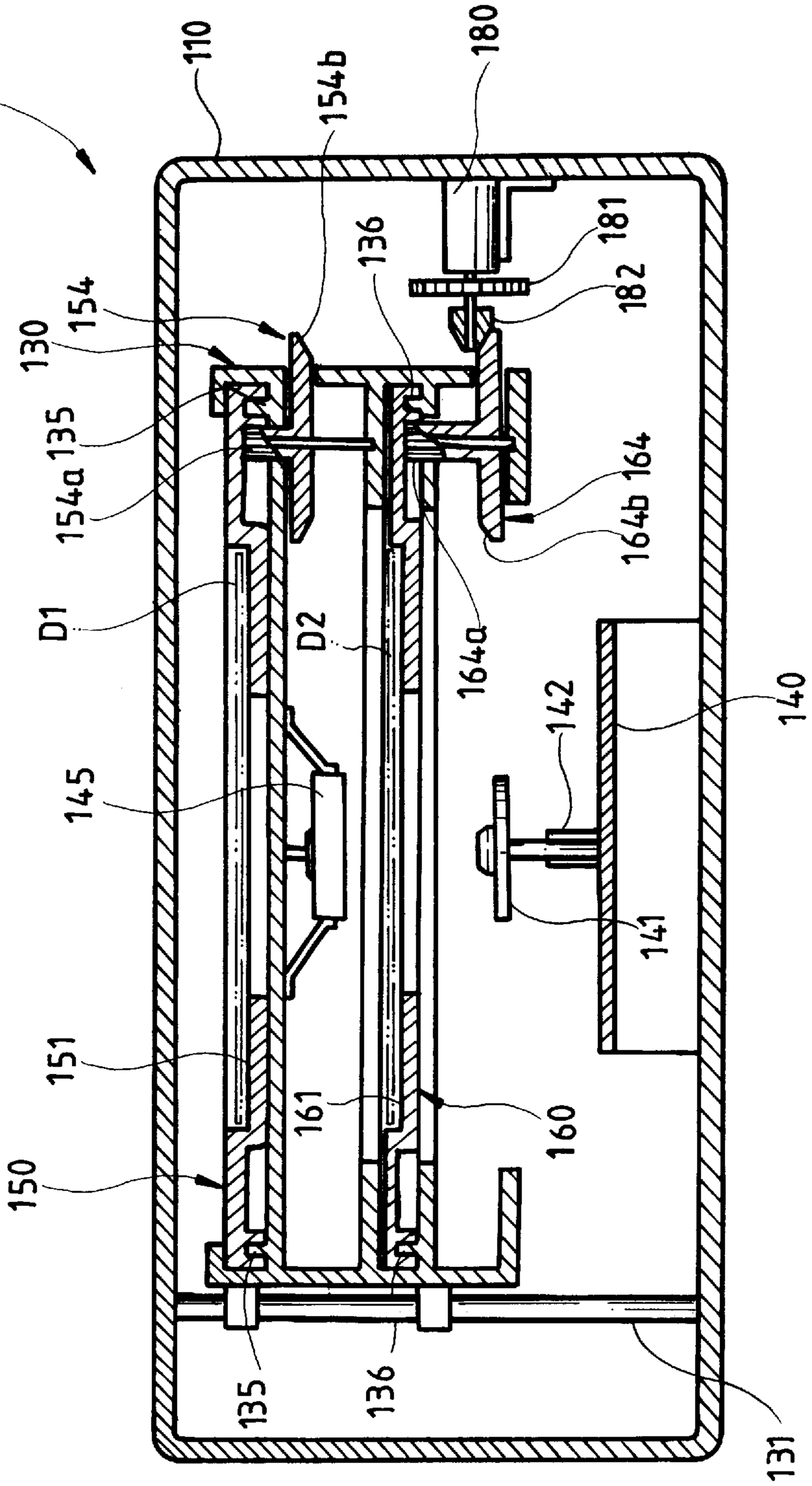

100
110
154b
180
181
182
136
154
130
135
154a
164
164b
D1
D2
64a
142
140
145
141
151
161
160
150
135
136
131

FIG.4

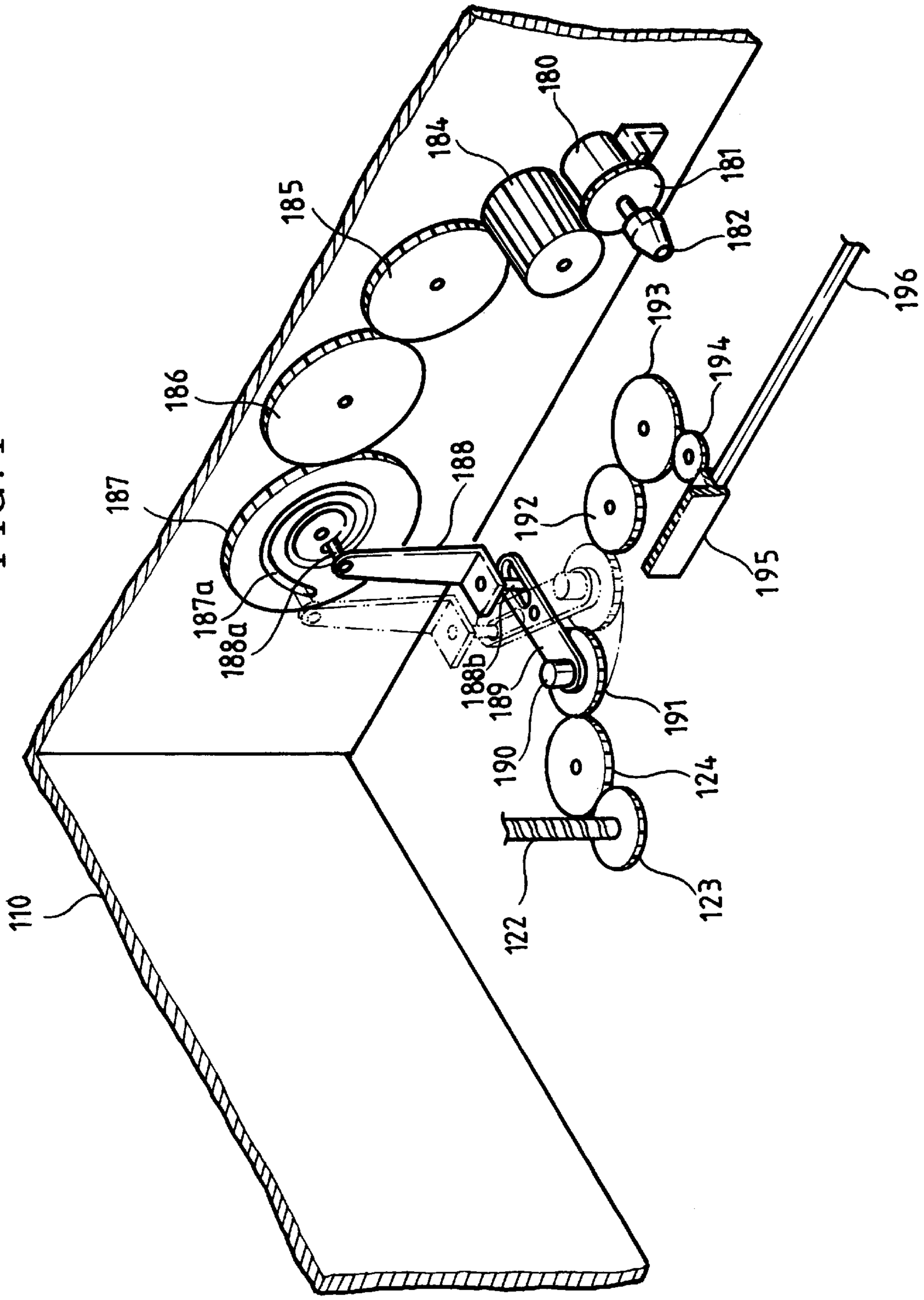

180
184
185
186
187
188
187a
188a
188b
189
190
191
192
193
194
195
196
181
182
110
122
123
124

FIG.5

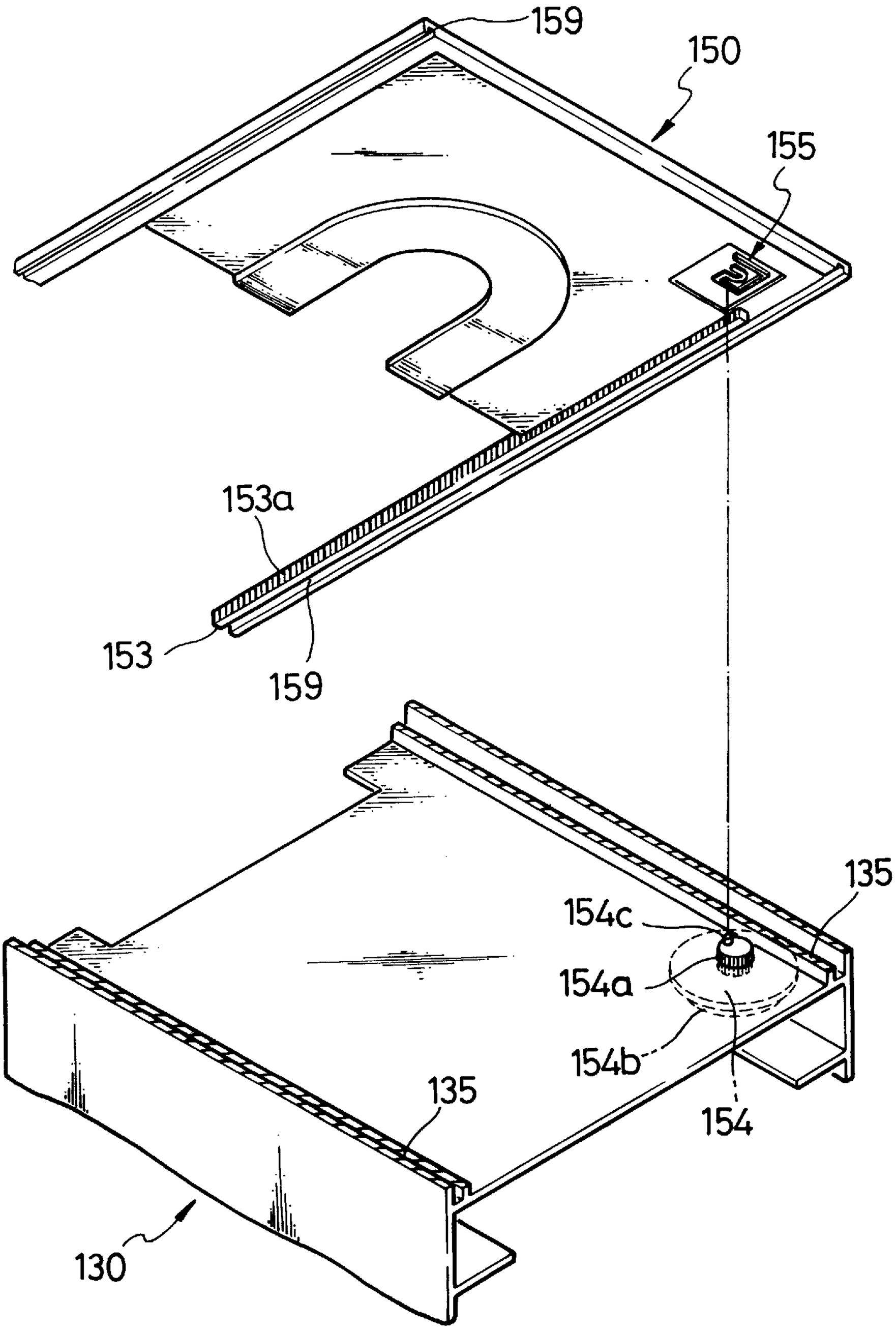
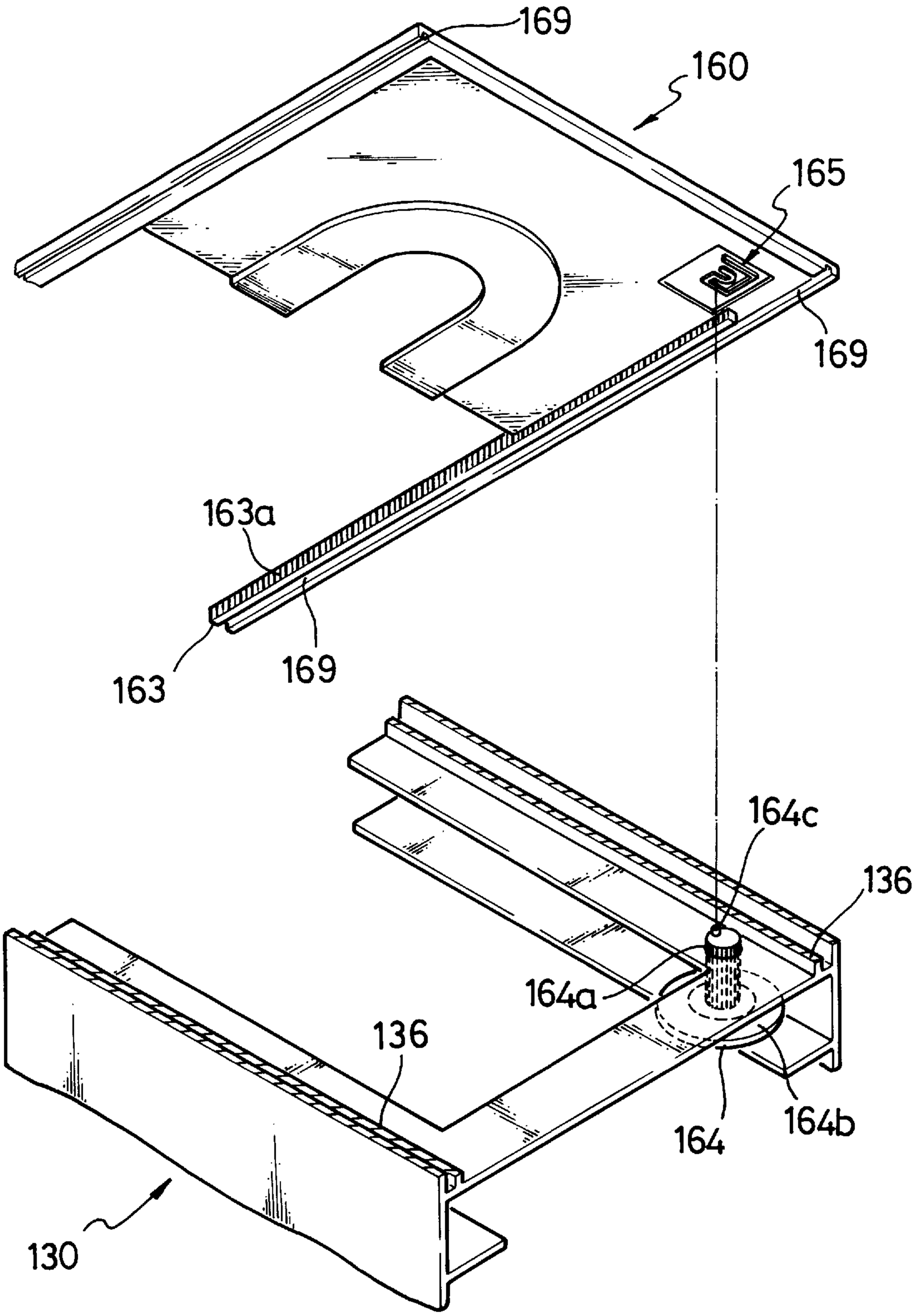


FIG.6



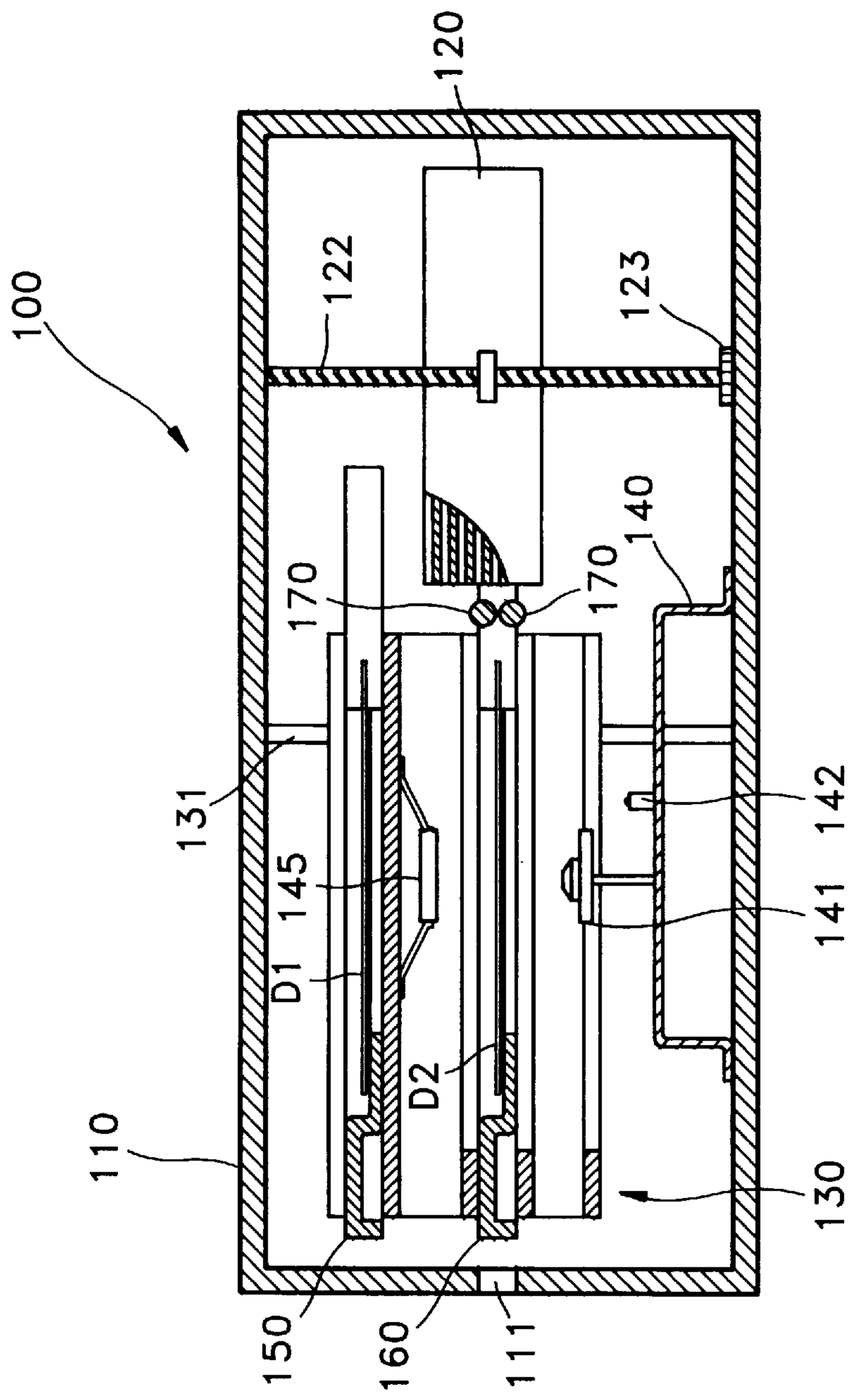


FIG.7

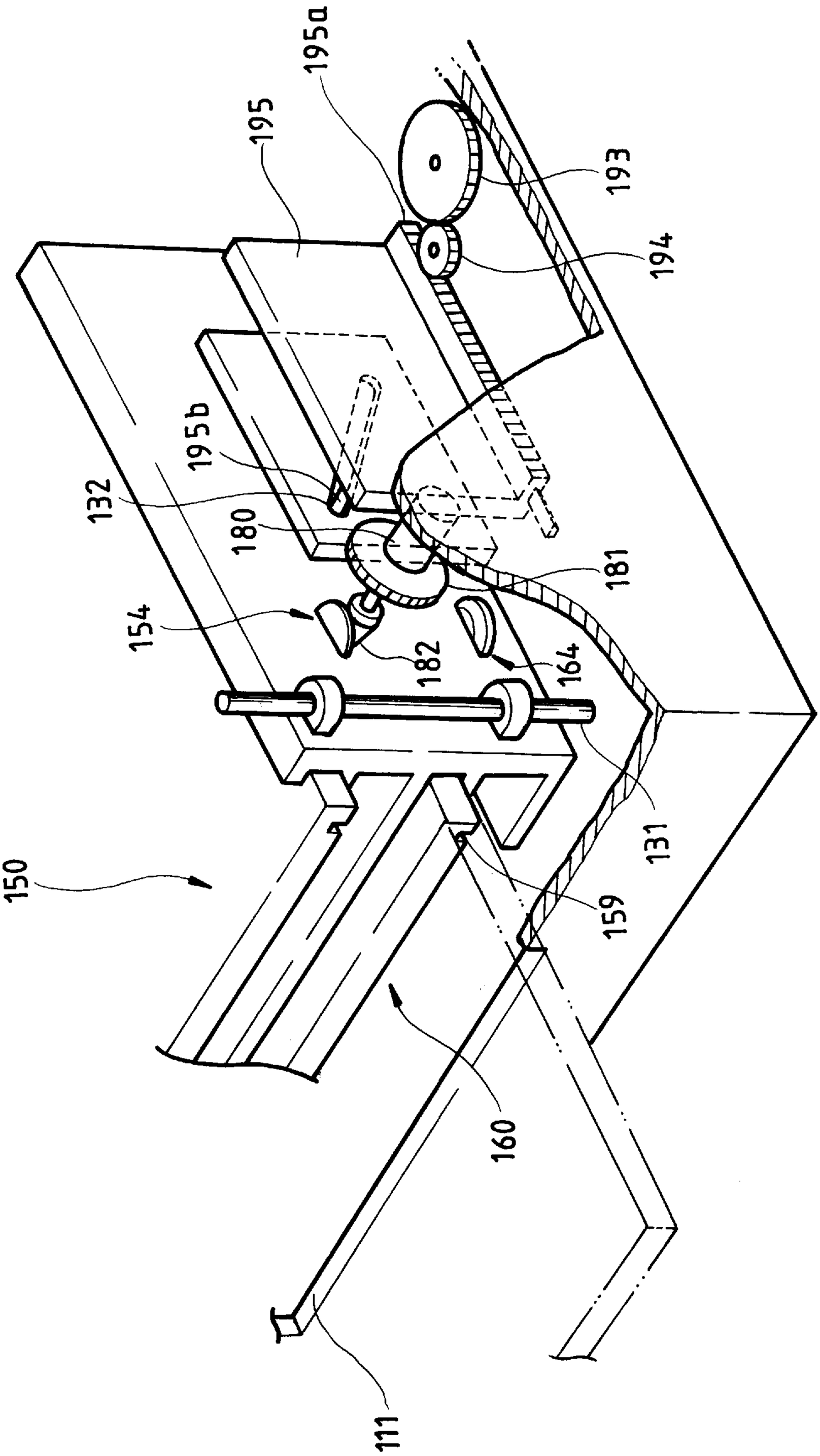

195a
195
193
194
195b
132
180
181
154
182
164
131
150
159
160
111

FIG. 8

FIG.9

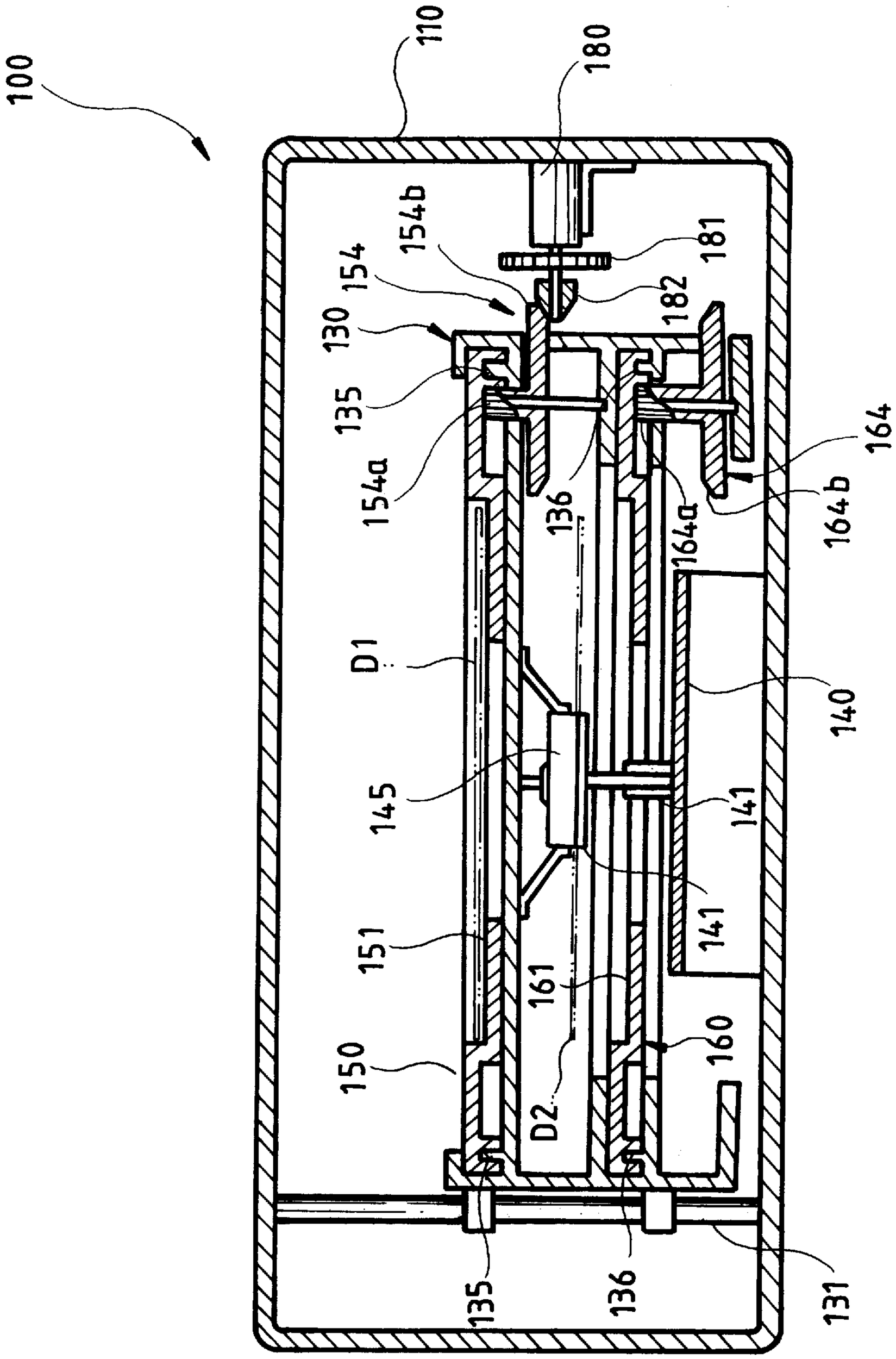

100
110
180
154b
154
130
135
154a
181
182
164
164b
164a
136
D1
145
151
161
150
D2
160
141
140
131

FIG. 10

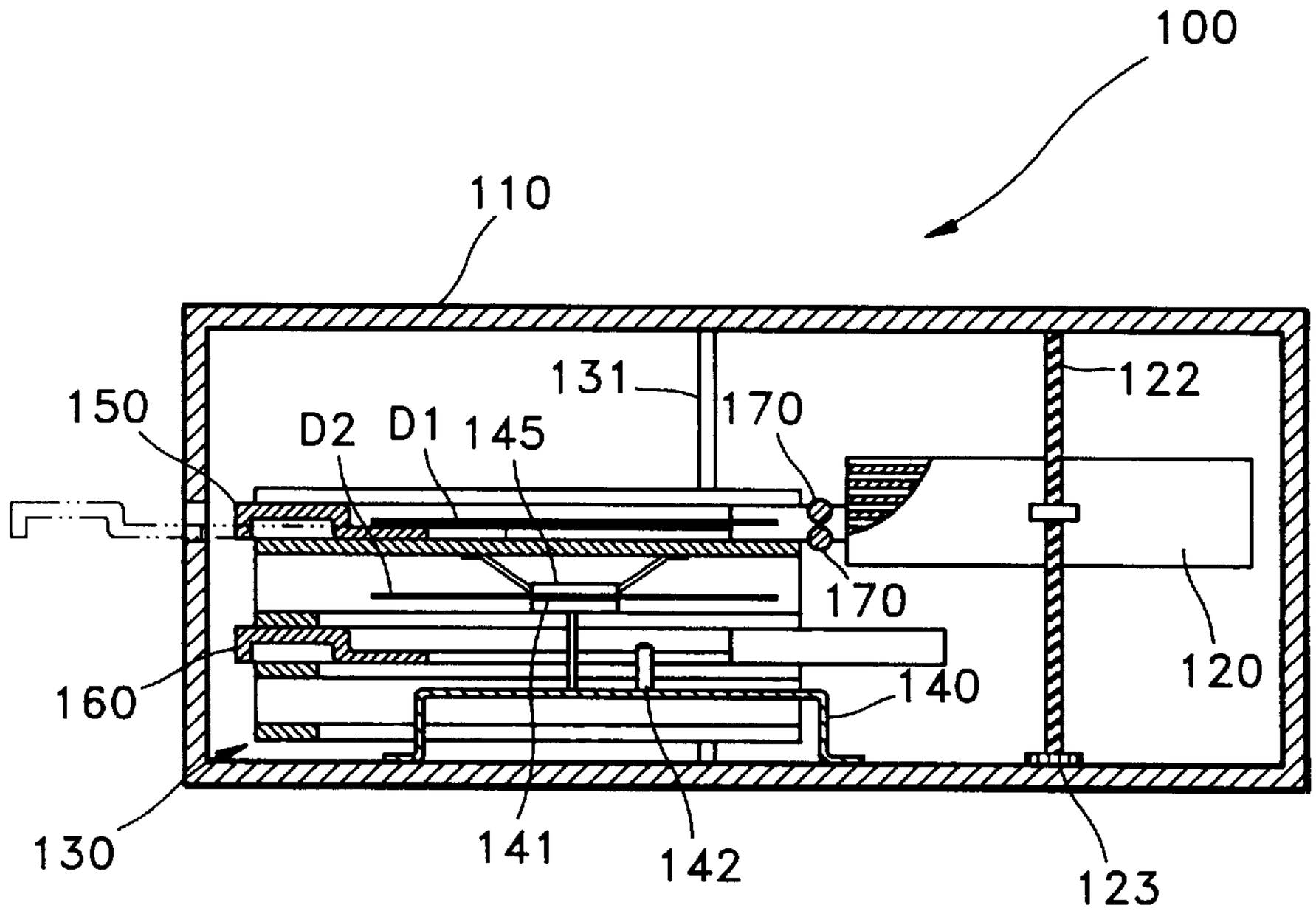

100
110
131
122
150
D2
D1
145
170
170
160
140
120
130
141
142
123

FIG. 11

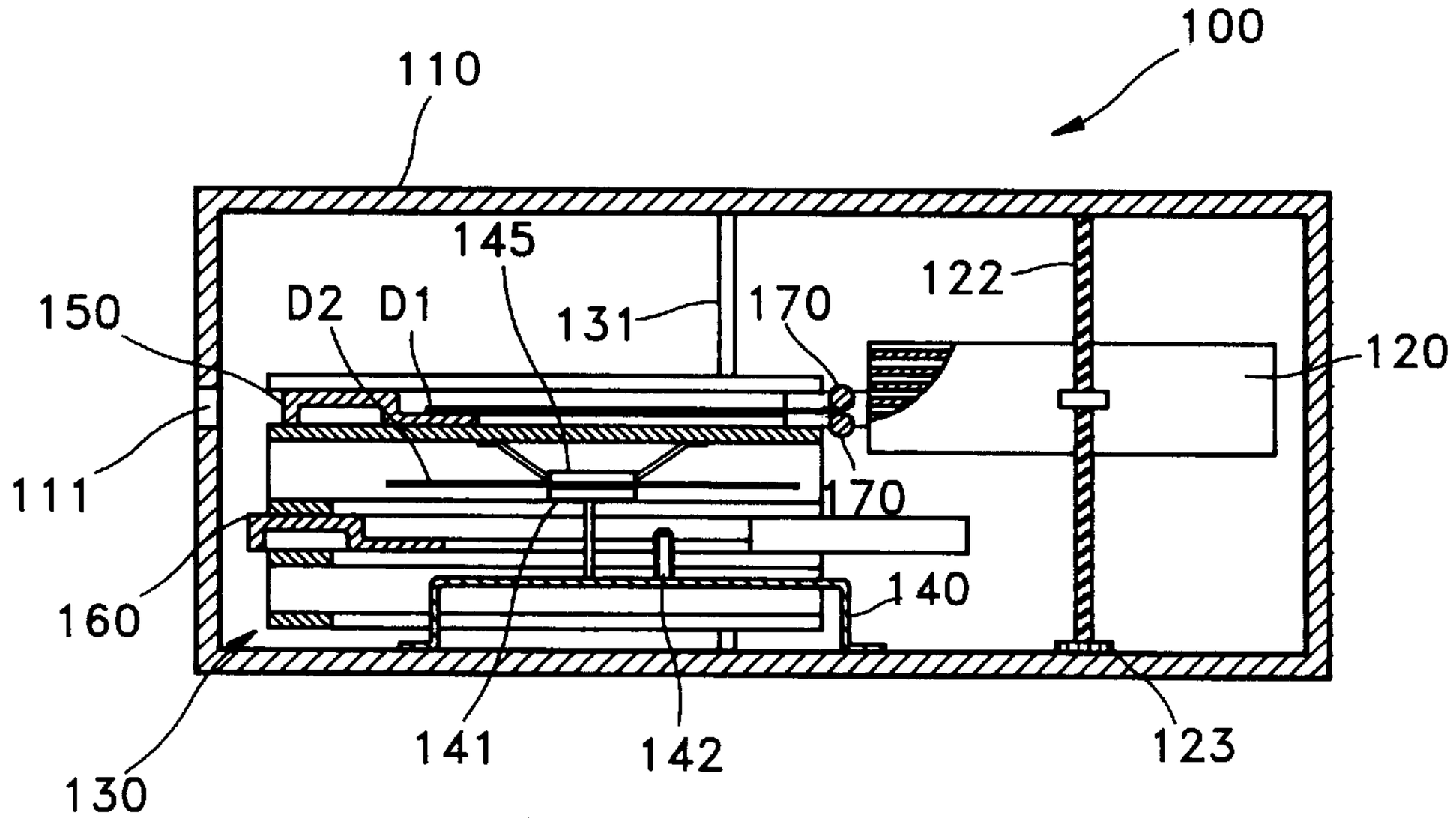

100
110
145
122
150
D2
D1
131
170
120
111
170
160
140
130
141
142
123

FIG. 12

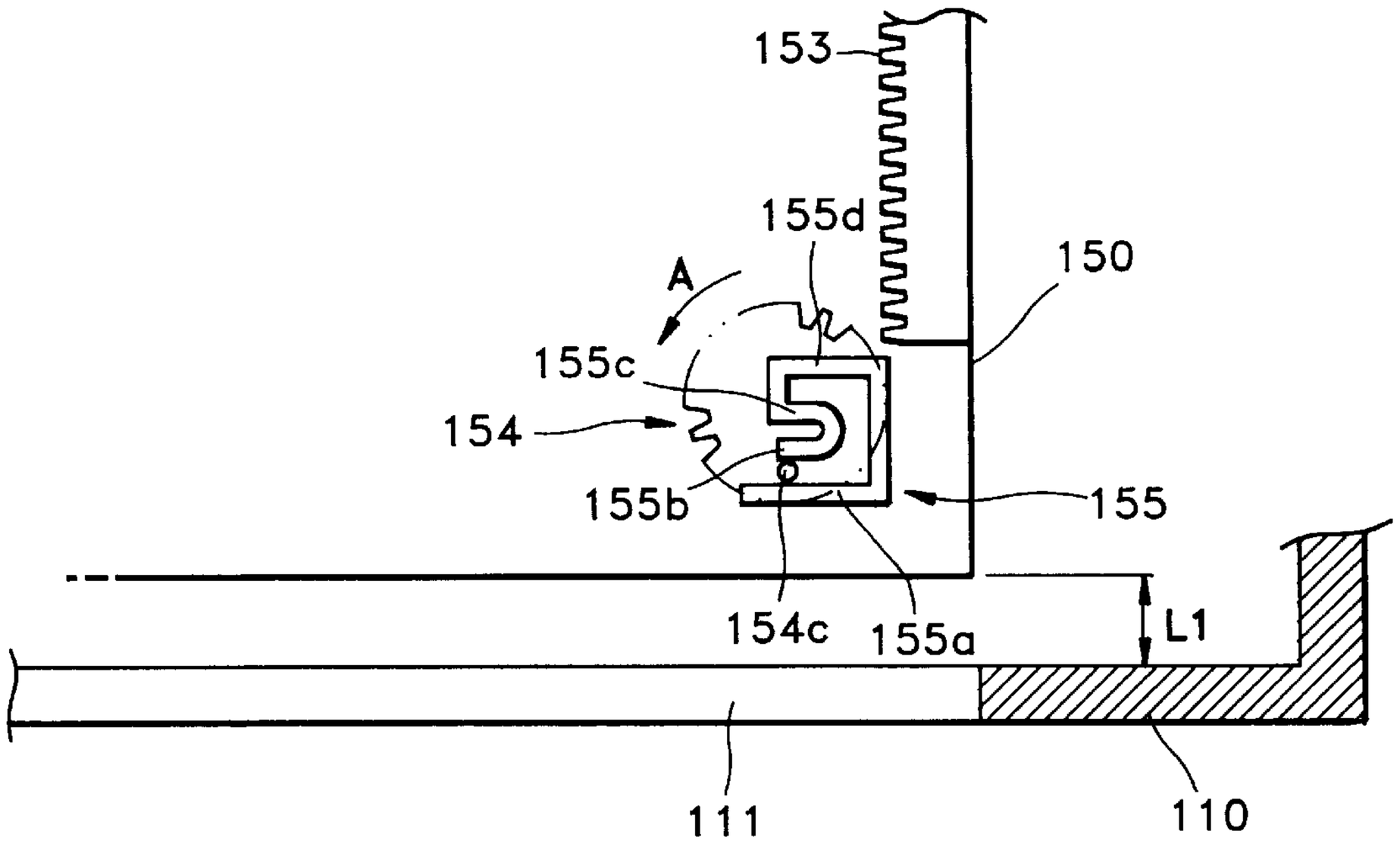

153
155d
A
150
155c
154
155b
155
154c
155a
L1
111
110

FIG. 13

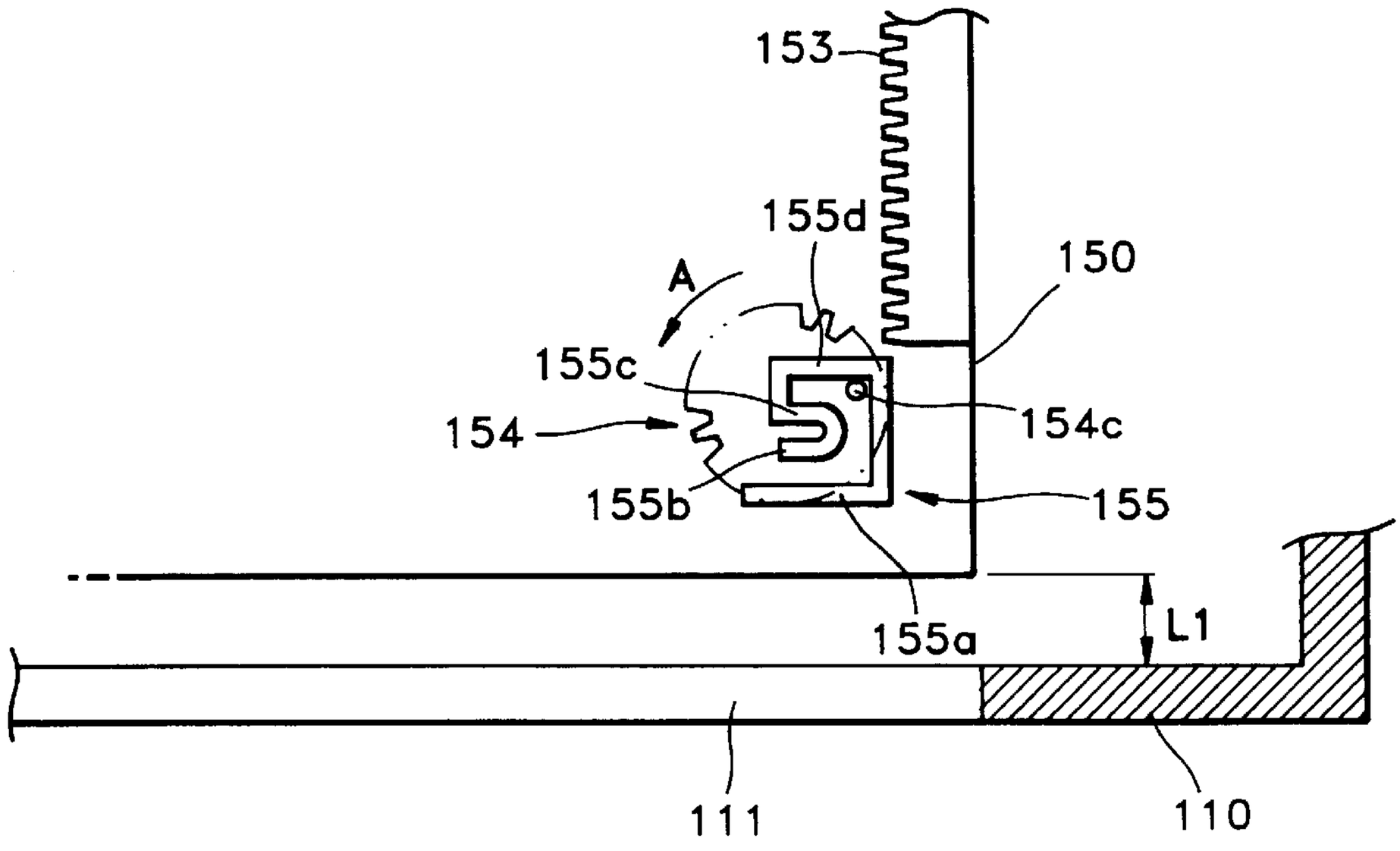

153
155d
A
150
155c
154
154c
155b
155
155a
L1
111
110

FIG. 14

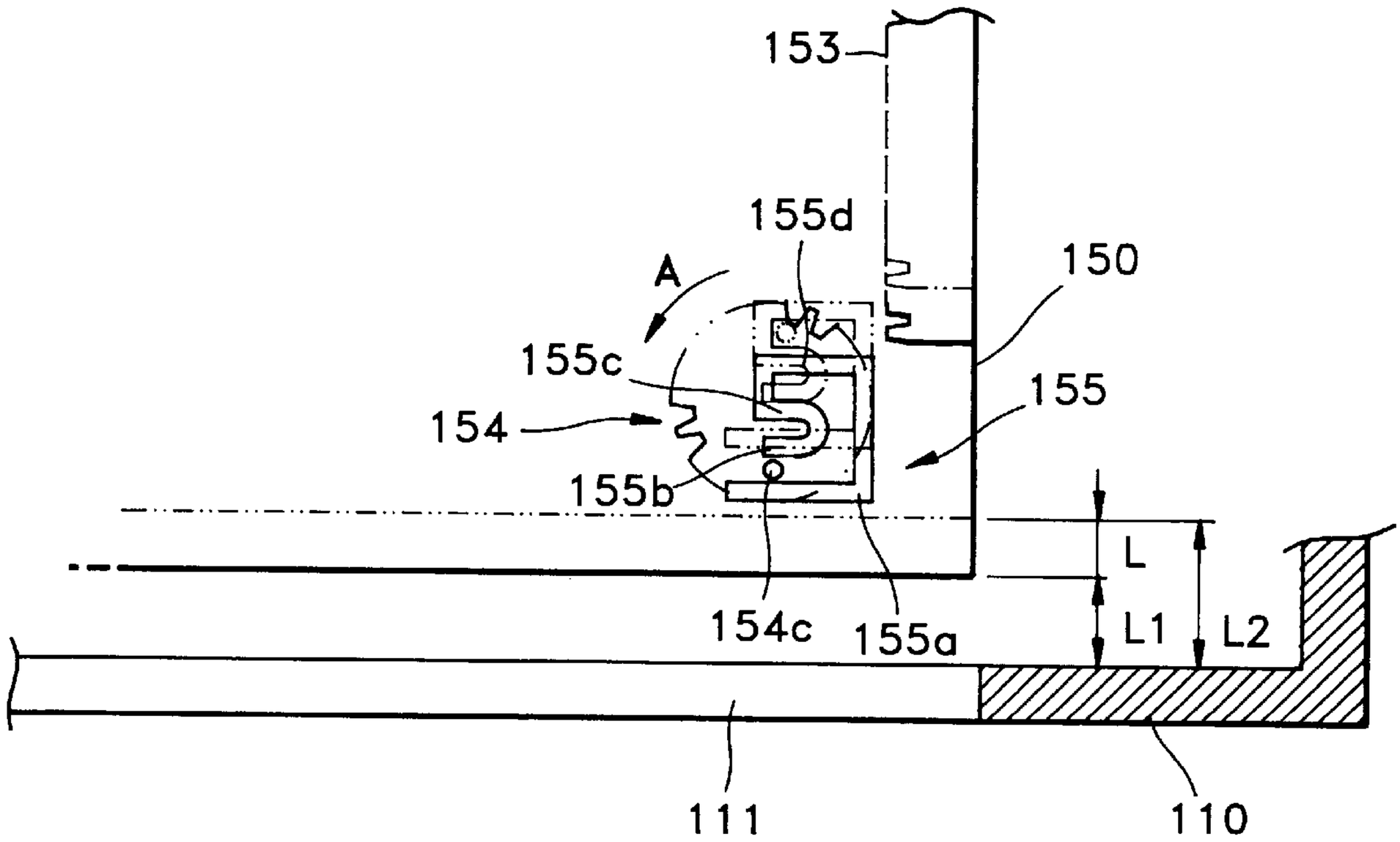

153
155d
150
A
155c
155
154
155b
L
L1
L2
154c
155a
111
110

FIG. 15

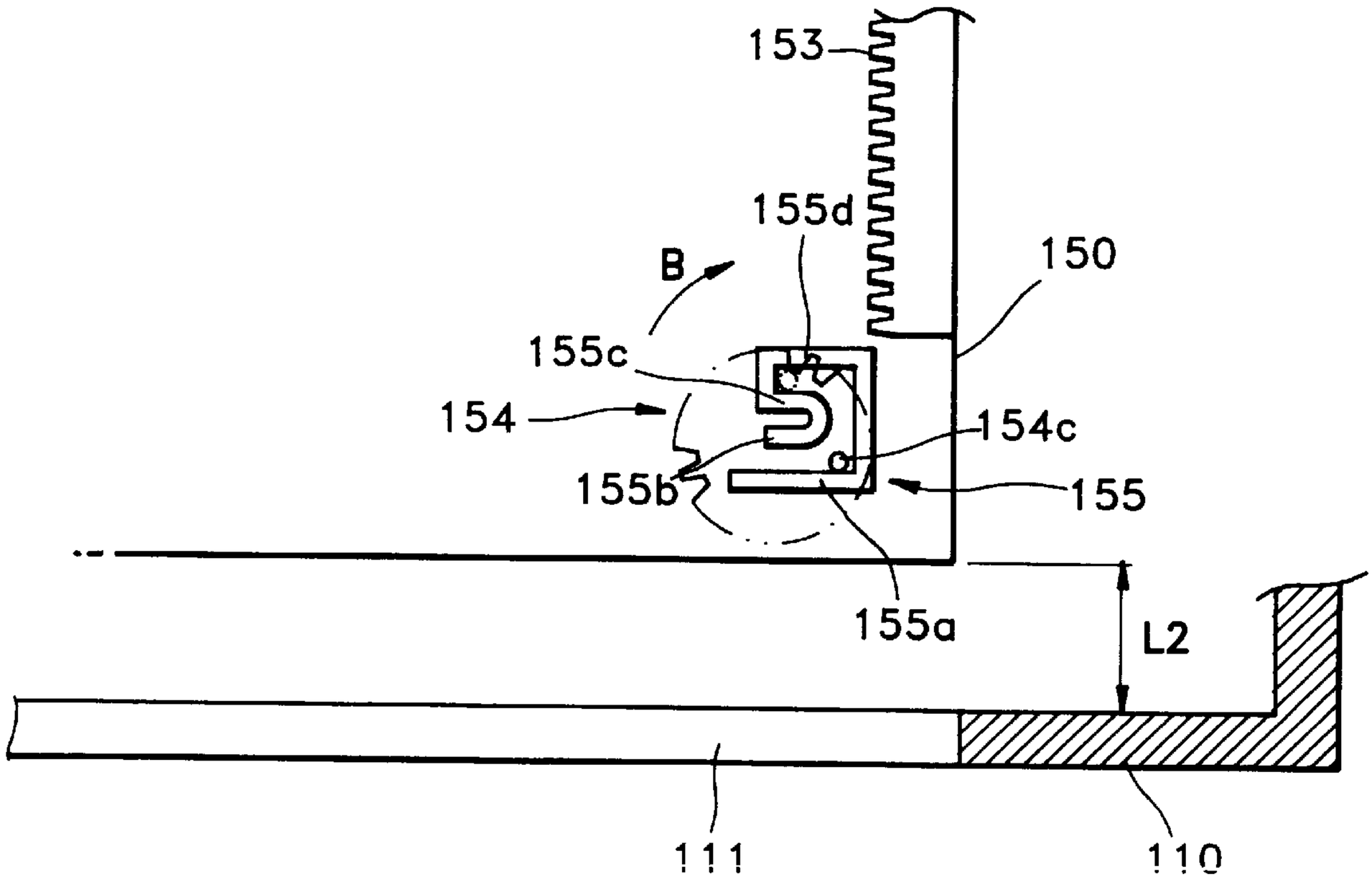

153
155d
150
B
155c
154
154c
155b
155
155a
L2
111
110

FIG. 16

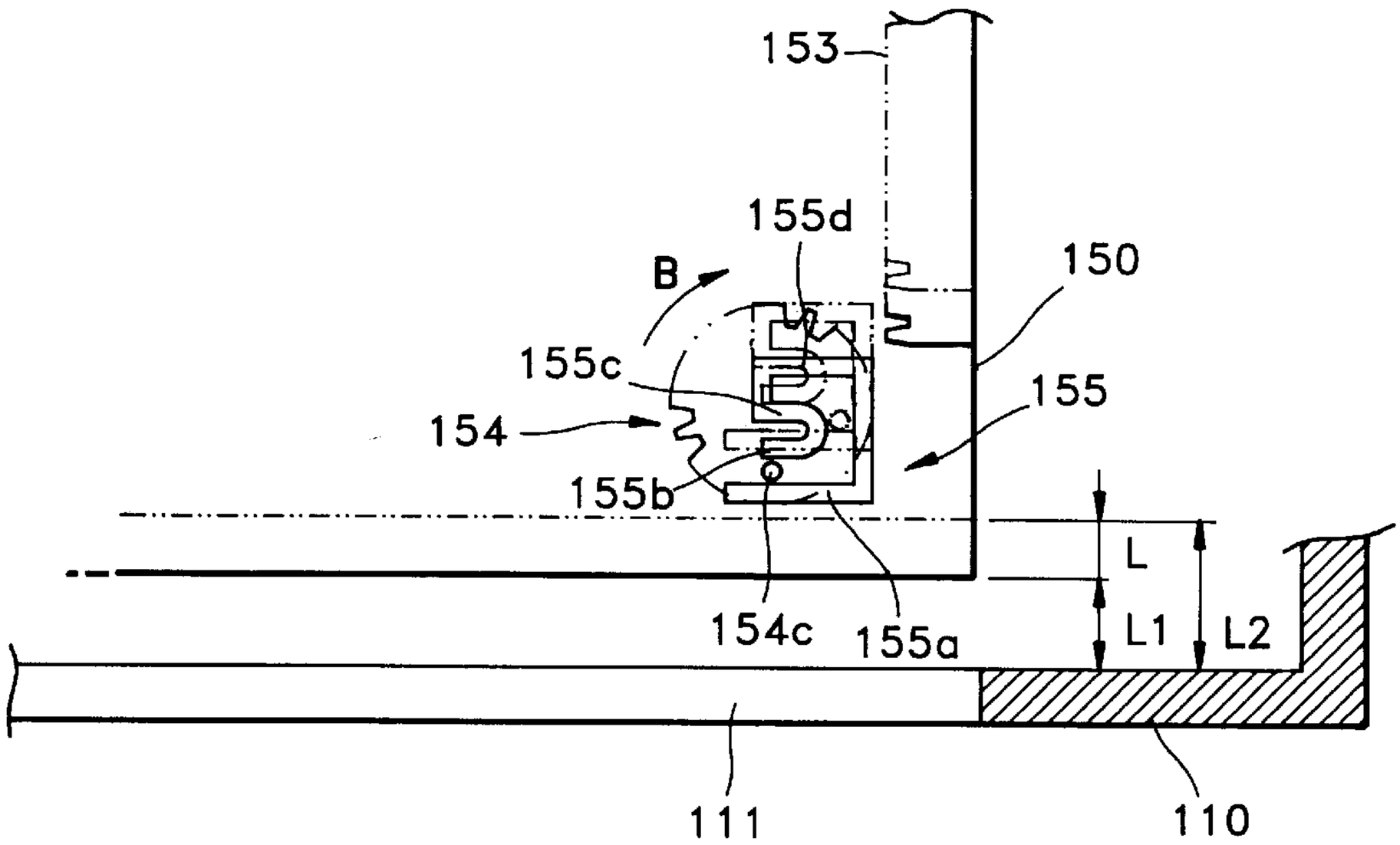

153
155d
B
150
155c
155
154
155b
L
L1
L2
154c
155a
111
110

FIG. 17

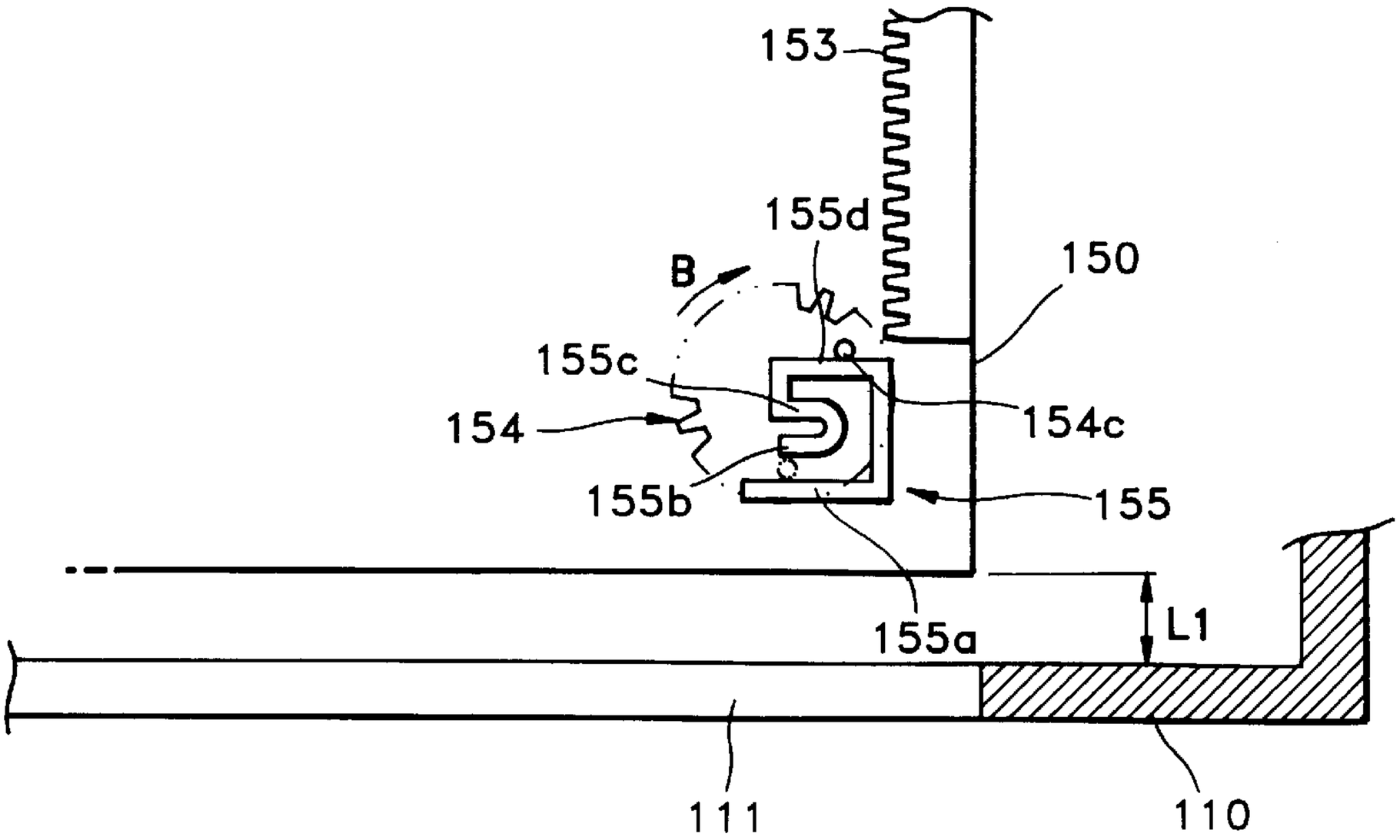

153
155d
B
150
155c
154c
154
155
155b
L1
155a
111
110

FIG.18

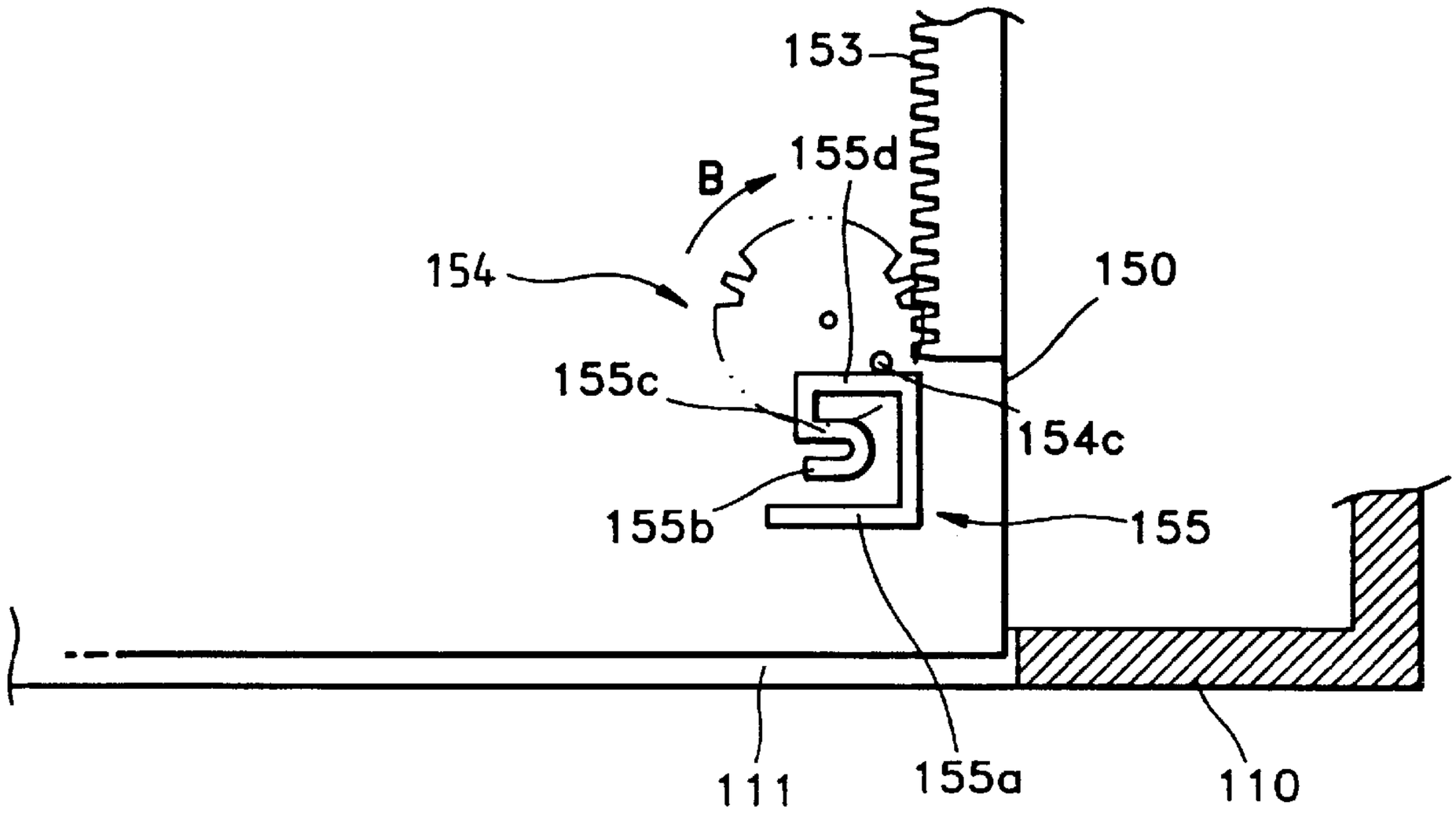

153
155d
B
154
150
155c
154c
155b
155
111
155a
110

FIG.19

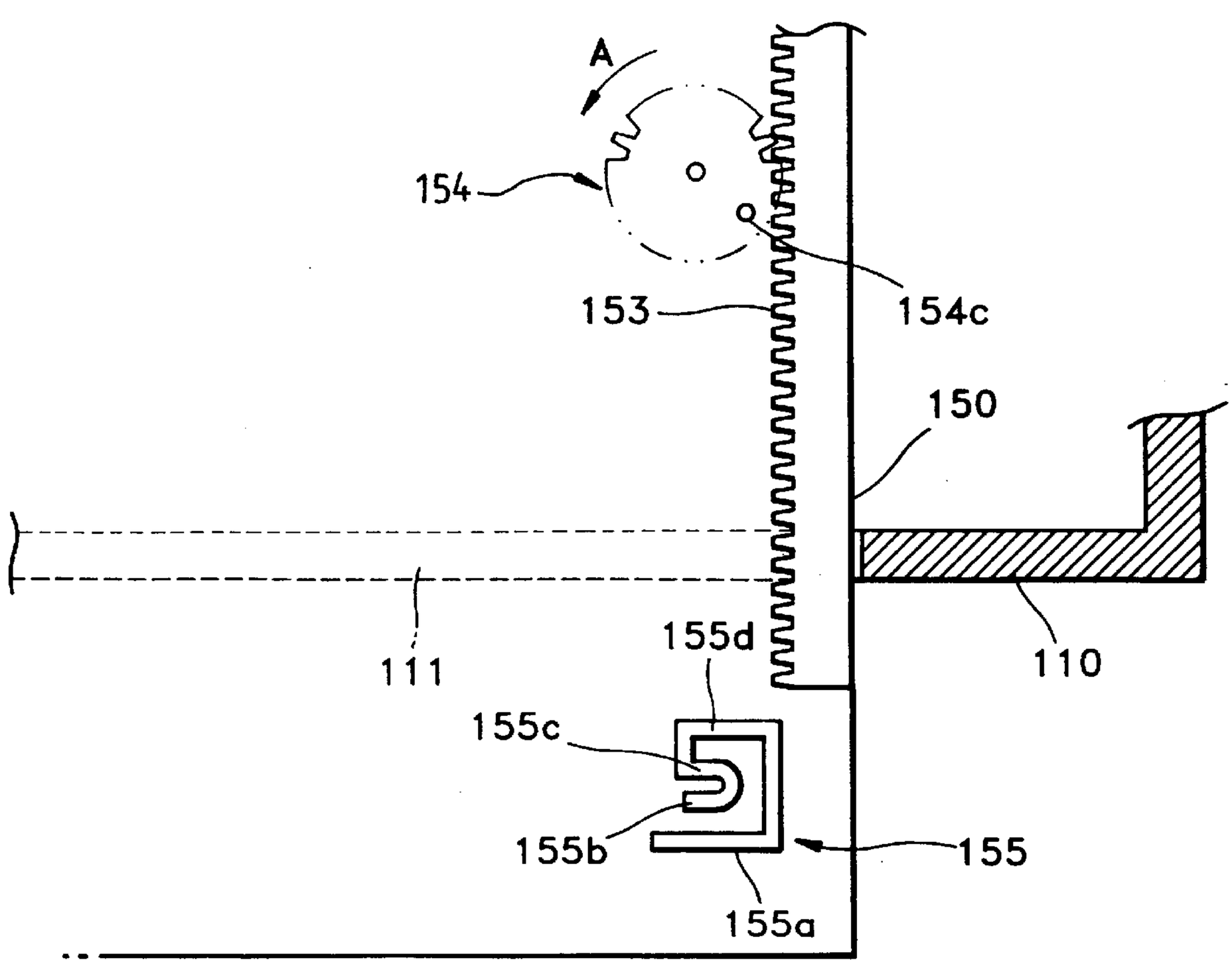

A
154
153
154c
150
111
155d
155c
155b
155
155a
110

FIG.20

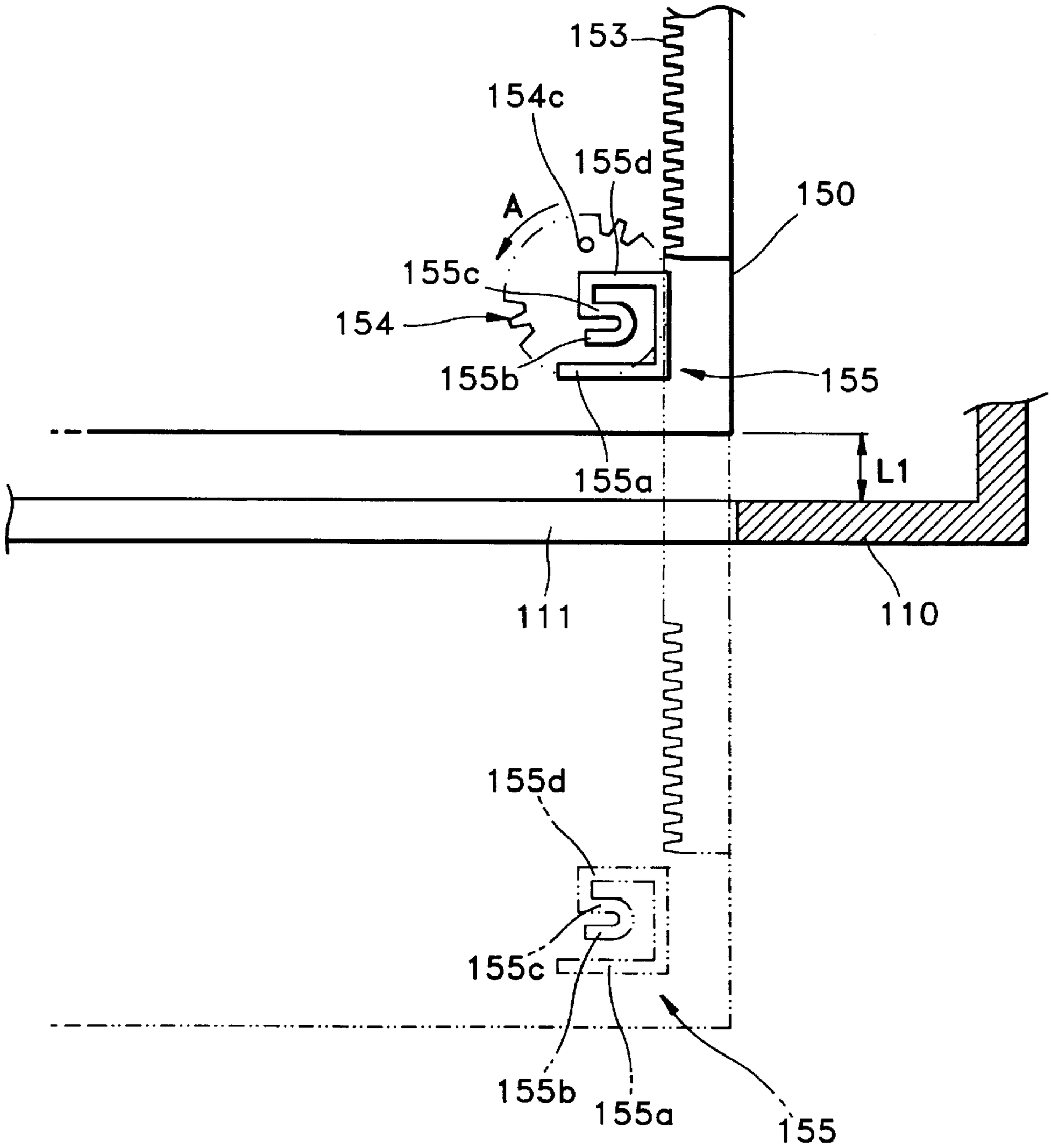
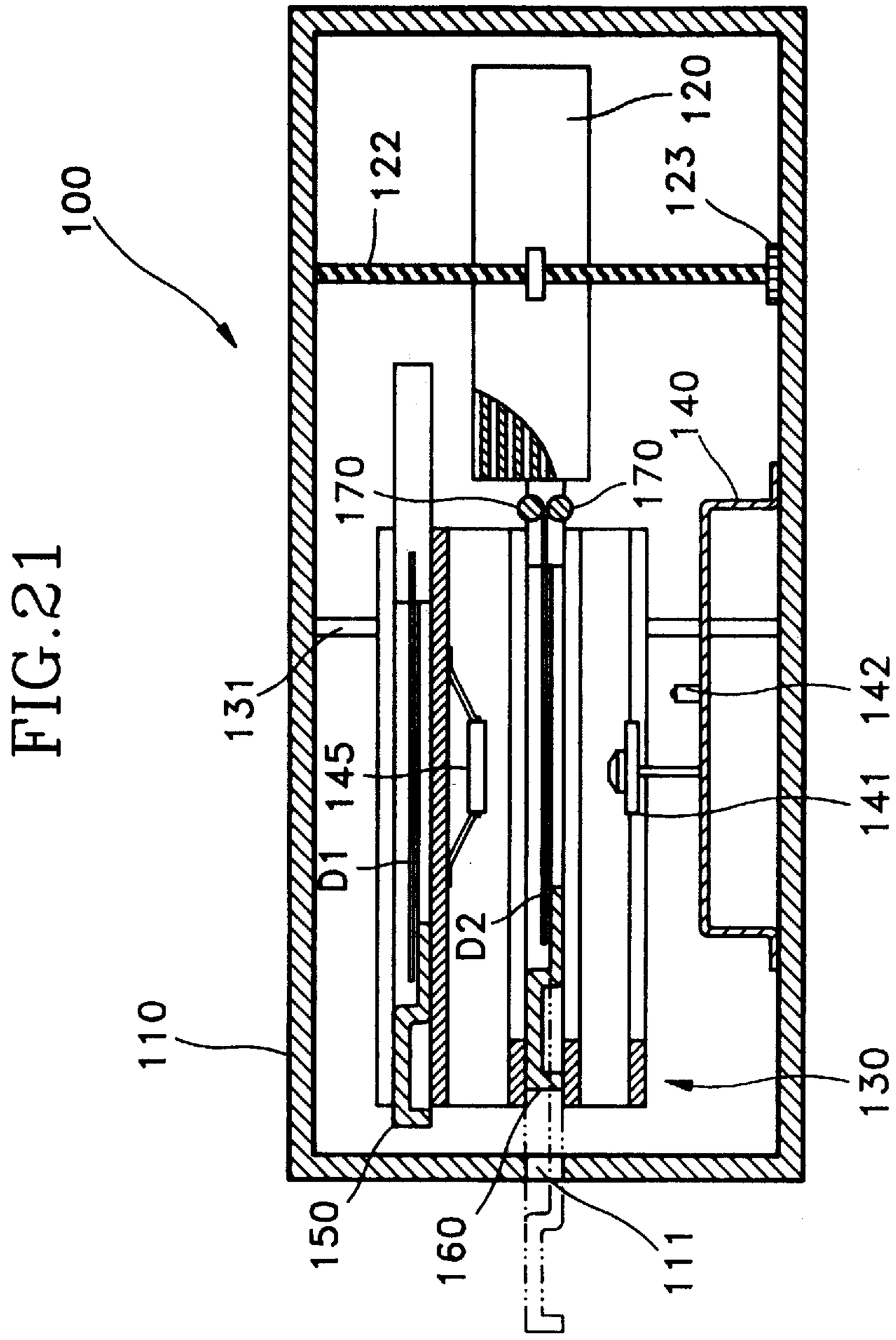

153
154c
155d
A
150
155c
154
155b
155
155a
L1
111
110
155d
155c
155b
155a
155

FIG.21


100
122
120
123
140
170
170
131
145
D1
D2
142
141
110
130
150
160
111

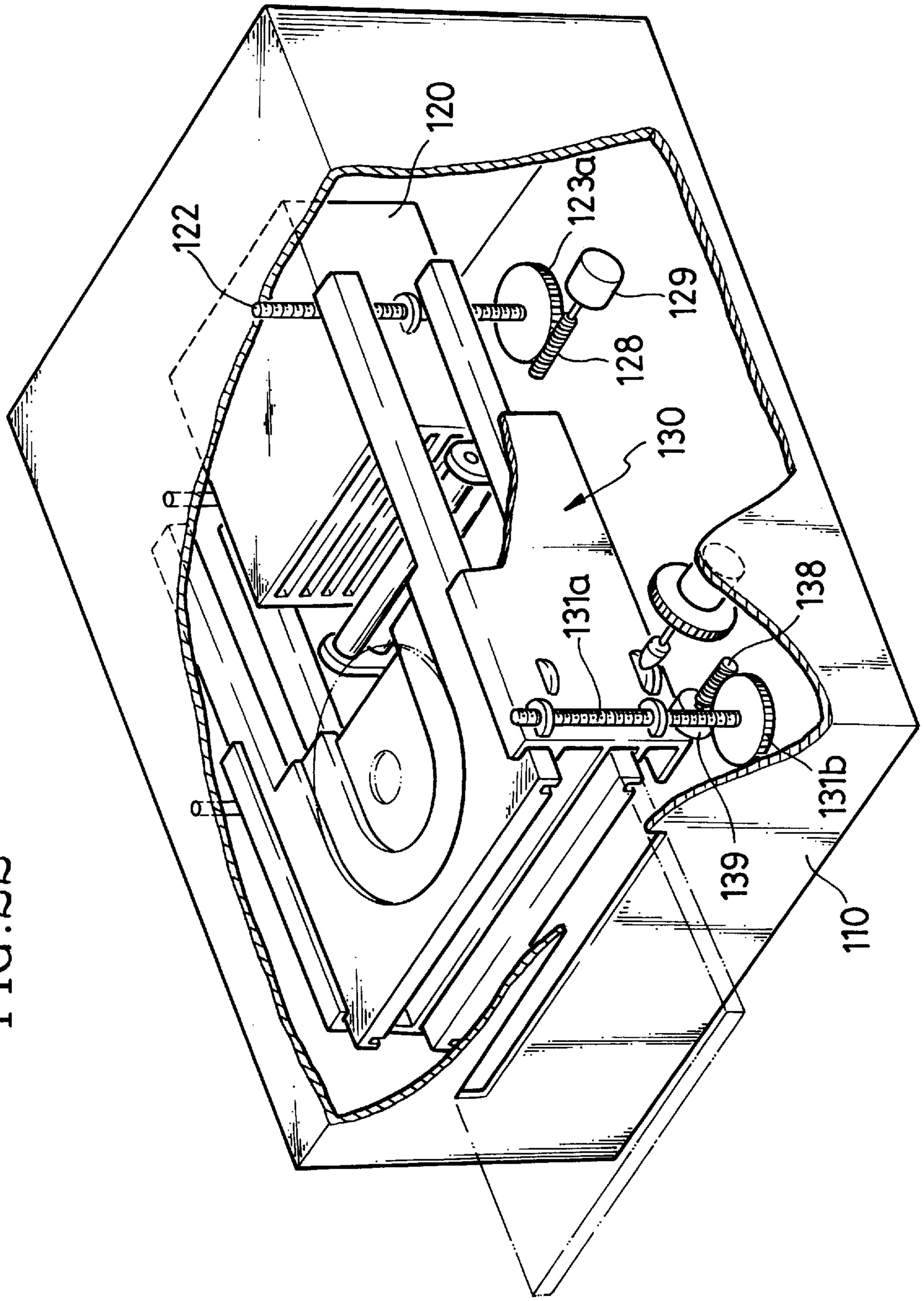


FIG.22

FIG.23

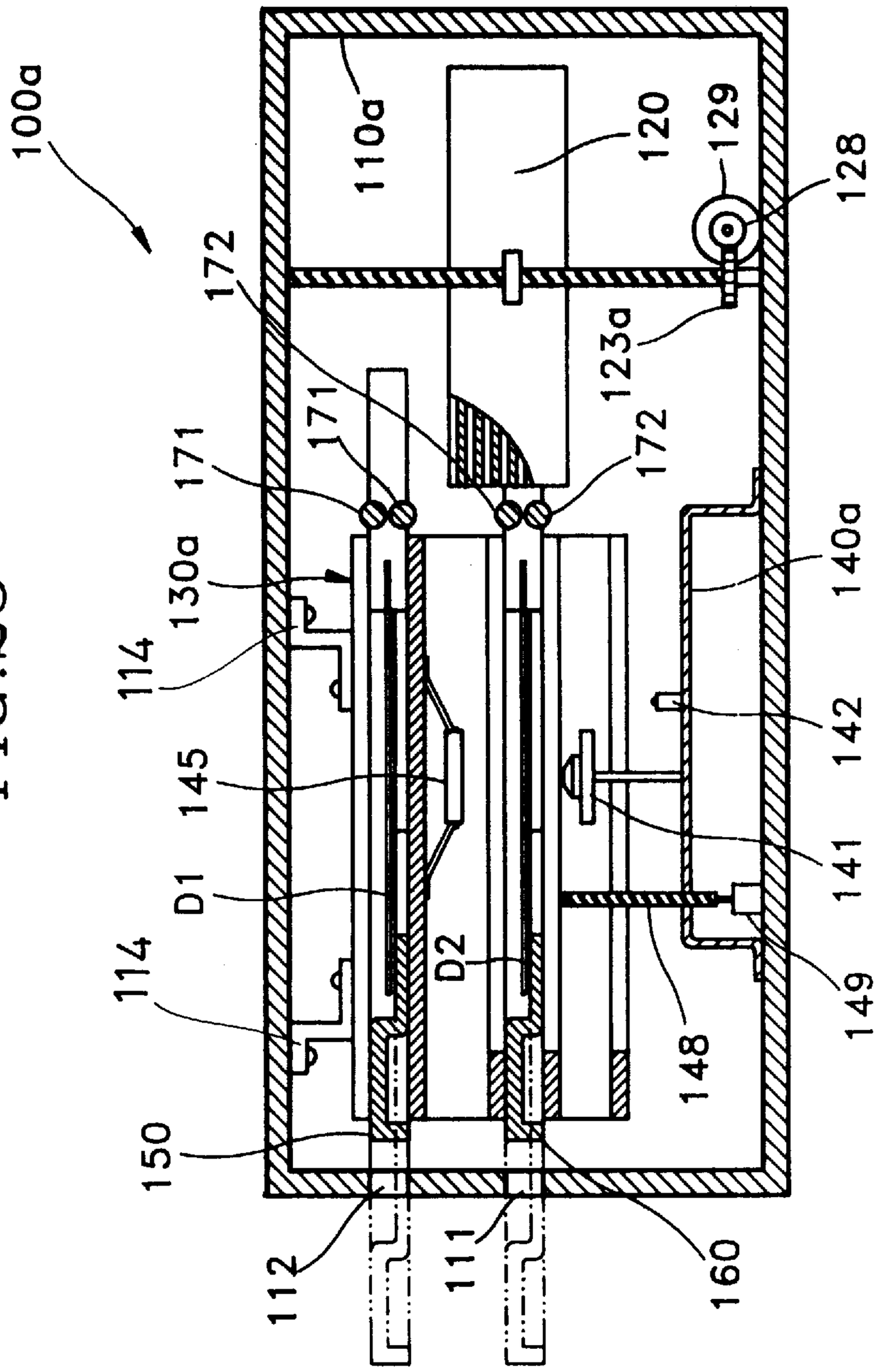
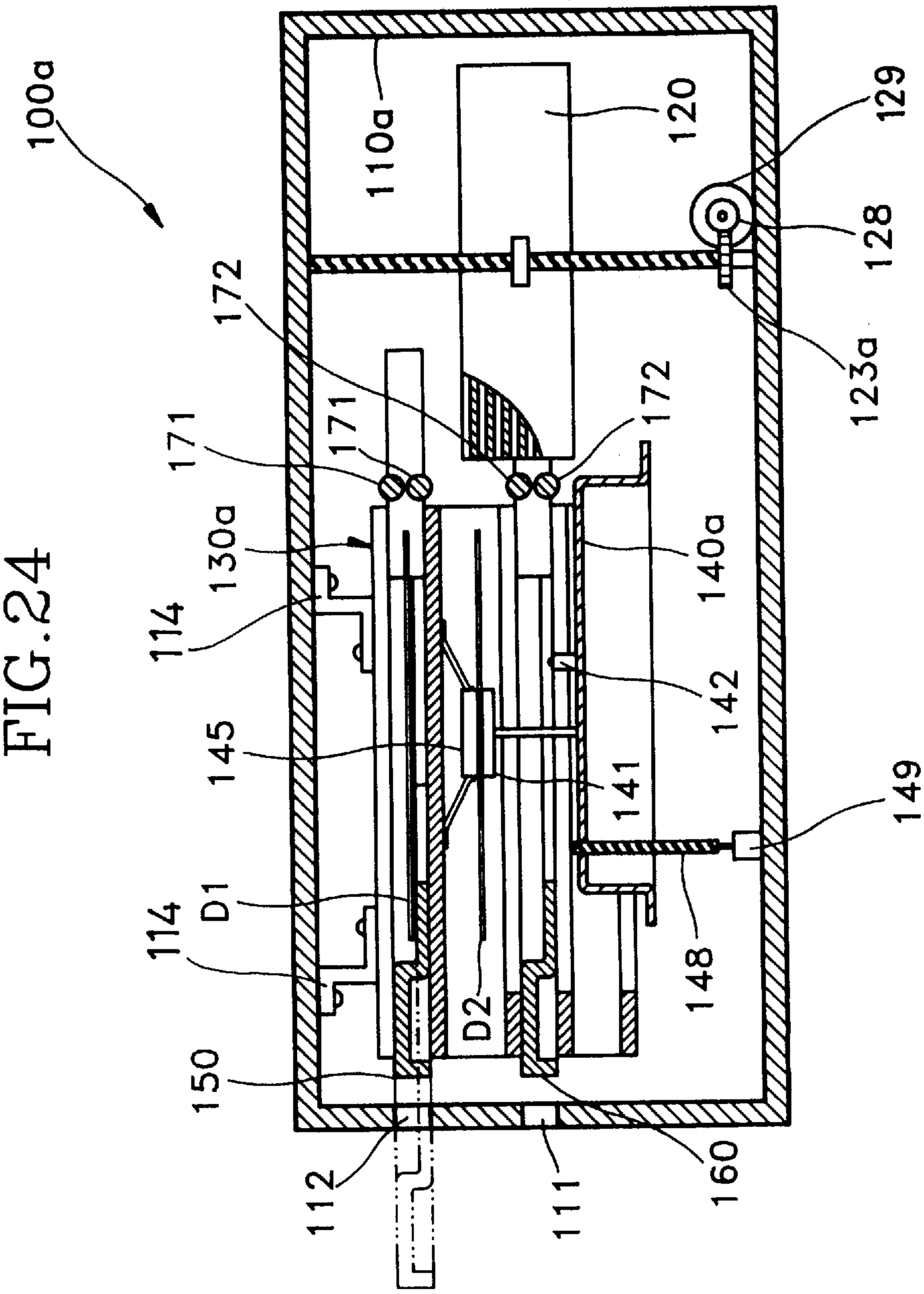

100a
110a
120
129
128
172
123a
171
172
171
172
140a
130a
114
142
145
141
D1
D2
114
149
148
150
112
111
160

FIG.24


100a
110a
120
129
128
123a
172
171
172
171
130a
114
140a
142
145
141
149
D1
114
D2
148
150
112
111
160

DISK RECORDING/REPRODUCING APPARATUS HAVING TWO TRAYS SO THAT A DISK IN A MAGAZINE CAN BE REPLACED BY ONE TRAY WHEN A DISK IN THE OTHER TRAY IS BEING RECORDED/REPRODUCED

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a disk recording/reproducing apparatus, and more particularly, to a disk recording/reproducing apparatus having a disk changer, for accommodating a plurality of disks, which is capable of changing disks while a disk is being reproduced.

2. Description of the Related Art

A disk recording/reproducing apparatus capable of recording/reproducing from a plurality of disks has some form of disk changer. In general, the disk changer can be classified as one of a roulette type, a fixed magazine type, and an elevator type. The roulette-type disk changer selects a disk from a rotating tray of circularly arranged disks on a turntable similar to a roulette wheel. The fixed magazine type disk changer selects a disk by extracting one disk from a stack of disks stored in slots of a magazine cassette. The elevator-type disk changer stores disks in the same manner as the fixed magazine type but selects a disk by moving the magazine cassette up and down to then position the selected disk for reading or recording by an optical pickup.

In a disk recording/reproducing apparatus having a disk changer, a plurality of disks can be individually selected and reproduced rapidly for hours of uninterrupted play without having to manually change disks. However, when a user wishes to play an external disk which is not already loaded in the disk changer the play operation must be halted and the user must replace a disk in the disk changer with the external disk causing a break in the continuous reproduction of music or the like recorded on the disks.

FIG. **1** is a cross-sectional view of a conventional elevator-type disk recording/reproducing apparatus. In this apparatus, a disk reproducing unit **30** is positioned behind openings **33**, near the front of the apparatus, and a disk storage **20** accommodating a plurality of subtrays **23***a* through **23***f* is positioned in the rear of the apparatus. The plurality of the subtrays **23***a* through **23***f* each can accommodate one disk. However, one subtray **23***a* among the plurality of the subtrays **23***a* through **23***f* is left unoccupied.

A clamp arm **64**, to which a clamp **71** for clamping a disk to a turntable is supported, is installed in the upper portion of the disk reproducing unit **30**. A main tray **31** for housing the subtrays **23***a* through **23***f* is slidably installed between the clamp **71** and the disk reproducing unit **30**. The plurality of subtrays **23***a* through **23***f* are movable from the disk storage **20** to the main tray **31** by means of rollers **91** and **92**.

The elevator-type disk recording/reproducing apparatus operates as follows. When reproducing a disk that is not stored in the disk storage **20**, the empty subtray **23***a* is moved to the main tray **31** by means of the driving rollers **91** and **92** and is projected outside the body of the apparatus via the openings **33** together with the main tray **31**, allowing a desired disk for reproduction to be set in the subtray **23***a*. Thereafter, the main tray **31** and subtray **23***a* are transferred to a disk reproducing position, then, the subtray **23***a* is lowered by a predetermined operating means to seat the disk on a turntable. Subsequently, the clamp arm **64** descends to secure the disk to the turntable with clamp **71**.

In the conventional disk recording/reproducing apparatus, since at least one subtray is left unoccupied, an external disk can be accommodated in the empty subtray. However, in such a conventional disk recording/reproducing apparatus, the reproduction/recording of a disk must be stopped for replacement of a disk among those in the subtrays, since an external disk cannot be exchanged with a disk accommodated in the subtray during disk reproduction.

SUMMARY OF THE INVENTION

To solve the problems of the conventional device noted above, it is an object of the present invention to provide a disk recording/reproducing apparatus, having a magazine accommodating a plurality of disks, which can exchange a disk accommodated in the magazine with an external disk during a disk reproducing operation.

To accomplish the above object, there is provided a disk recording/reproducing apparatus including: a housing having at least one disk entrance formed in its front wall, a magazine having a stack of disk receivers installed at the rear of the housing, means for elevating the magazine, a subtray and a deck each installed inside the housing between the disk entrance and the magazine, the subtray and the deck being relatively movable toward and away from each other, means for moving the subtray and deck relatively, a first tray having a first disk seating unit on the upper portion thereof and installed on the subtray to be movable horizontally with respect to the housing, means for transferring the first tray horizontally, a first transferring means for placing the disk in the magazine onto the first disk seating unit or moving the disk from the first disk seating unit into the magazine, a second tray having a second disk seating unit on the upper portion thereof and supported by the subtray between the deck and the first tray, a second transferring means for placing the disk in the magazine onto the second disk seating unit or moving the disk from the second disk seating unit into the magazine, a turntable installed on the deck and extending from the second disk seating unit, during the relative movement of the subtray and the deck toward each other, so that the turntable raises the disk from the second disk seating unit thereonto, and an optical pickup installed on the deck, wherein the first tray is positioned at the same height as one of the disk entrances so as to be insertable into/extractable from the disk entrance by the first tray transferring means while the deck records/reproduces information onto/from a disk on the second tray.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. **1** is a schematic diagram of a conventional elevator magazine-type disk recording/reproducing apparatus;

FIG. **2** is a schematic perspective view of a disk recording/reproducing apparatus according to a preferred embodiment of the present invention;

FIG. **3** is a sectional view taken along the line III—III of FIG. **2**;

FIG. **4** is a schematic perspective view showing the inside of the housing shown in FIG. **2**;

FIG. **5** is an exploded perspective view of the first tray and the subtray shown in FIG. **2**;

FIG. **6** is an exploded perspective view of the second tray and the subtray shown in FIG. **2**;

FIG. **7** is a sectional view taken along the line VII—VII of FIG. **2**;

FIG. **8** is a sectional view showing important portions with the subtray in a lowered state;

FIG. **9** is a schematic sectional view, as in FIG. **3**, with the subtray in its lowered state;

FIG. **10** is a schematic sectional view, as in FIG. **7**, with the subtray in its lowered state;

FIG. **11** is a schematic sectional view showing the first tray moved to a second position;

FIGS. **12** through **14** are structural plan views of important portions, sequentially showing the positional relationship between a locking rib of the first tray and a connecting protrusion of a first rotator when the first tray is transferred from a first position to a second position;

FIGS. **15** and **16** are structural plan views of important portions, sequentially showing the positional relationship between a locking rib of the first tray and a connecting protrusion of the first rotator when the first tray is transferred from the second position to the first position;

FIGS. **17** through **19** are structural plan views of important portions, sequentially showing the positional relationship between a locking rib of the first tray and a connecting protrusion of the first rotator when the first tray is transferred from the first position to the position where the first tray is projected to the outside of the housing via an opening of the housing;

FIG. **20** is a structural plan view of important portions, showing the positional relationship between a locking rib of the first tray and a connecting protrusion of the first rotator when the first tray projected to the outside of the housing is moved back inside of the housing;

FIG. **21** is a schematic sectional view showing the second tray moved to the second position; and

FIG. **22** is a structural plan view of a second preferred embodiment of the present invention.

FIG. **23** is a sectional view of a third preferred embodiment of the present invention; and

FIG. **24** is a structural plan view of the deck in a lowered state in the recording/reproducing apparatus shown in FIG. **23**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **2** through **7**, the first preferred embodiment of the disk recording/reproducing apparatus **100** has a disk entrance **111** formed in a front wall thereof so that a disk can be inserted into and ejected from the inside of a housing **110**. A magazine **120**, having multilayer disk receivers **121** disposed therein for receiving a plurality of disks, is provided inside the housing **110** at a rear portion of the housing **110**. The magazine **120** is screw-coupled to a screw stock **122** which is rotatably connected to the housing **110**. The magazine **120** is also connected to a guide stock **122***a* and moves up or down along the guide stock **122***a* as the screw stock **122** is rotated.

As is best illustrated in FIG. **3**, a subtray **130** and a deck **140** are installed between the disk entrance **111** and the magazine **120**. The subtray **130** is movably installed on guide stocks **131** and the deck **140** is fixed at the bottom of the housing **110**.

A first tray **150** is supported in the upper portion of the subtray **130** and a second tray **160** is supported in the lower portion of the subtray **130** between the first tray **150** and the deck **140**. The first tray **150** and second tray **160** are vertically spaced from each other by the elevating distance of the subtray **130**. The second tray **160** is positioned at the same height as that of the disk entrance **111** when the subtray **130** is in a raised state, and the first tray **150** is positioned at the height of the disk entrance **111** when the subtray **130** is in a lowered state. A disk seating unit **151** in which a disk D1 is seated is formed on top of the first tray **150**, and a parallel pair of guiding units **152** and **153** (see FIG. **2**) which extend to the back of the housing are installed at both sides of the first tray **150**. As shown in FIG. **5**, guide grooves **159** are formed in the bottoms of the respective guiding units **152** and **153**. Each guide groove **159** slidably connects to a pair of guide rails **135** formed at the sides of the subtray **130** beneath the first tray **150**. Thus, the first tray **150** can move forward and backward with respect to the housing **110** on the subtray **130**.

A rack **153***a* is formed on the inner side of the guiding unit **153** and extends from the leading edge of the guiding unit **153** to a position adjacent to a locking rib **155** at the other end thereof. As shown in FIG. **12**, the locking rib **155** protruding from the bottom of the first tray **150** has a first wall **155***a*, a second wall **155***b*, a third wall **155***c* and a fourth wall **155***d*, spaced apart from the front edge of the first tray **150**. The locking rib **155** constitutes means for transferring the first tray **150** to the front and rear of the housing, in combination with the rack **153***a*, a tray driving motor **180** (to be described later) and a first rotator **154** (to be described later).

The second tray **160** has the same configuration as that of the first tray **150**. In other words, there is a disk seating unit **161** formed on the upper portion of the second tray **160** onto which a disk D2 can be placed. The second tray **160** is movable horizontally forward and backward with respect to the housing **110**, by connecting guide grooves **169** formed at the bottoms of the respective guiding units **162** and **163**. The guide grooves **169** are slidably connected to a pair of guide rails **136** formed at the sides of the subtray **130** beneath the second tray **160**. Also, the second tray **160** has a rack **163***a* and a locking rib **165**, each having the same configuration as the corresponding elements of the first tray **150**. The locking rib **165** constitutes means for transferring the second tray **160** to the front and rear of the housing **110**, in combination with the rack **163***a*, the tray driving motor **180** and a second rotator **164** (to be described later).

Referring to FIGS. **3** and **5**, a first rotator **154** is rotatably installed at one end of the subtray **130**. A gear **154***a* is engaged with the rack **153***a* of the first tray **150** and is formed on the first rotator **154**, and a coupling protrusion **154***c* protrudes from a peripheral portion of an upper surface of the gear **154***a*. The rotation diameter of the coupling protrusion **154***c* is set to be larger than the interval between the first wall **155***a* and the fourth wall **155***d* of the locking rib **155** formed underneath the first tray **150**. A conical friction unit **154***b* is formed on the lower surface of the first rotator **154**.

The second rotator **164** having a gear **164***a*, a coupling protrusion **164***c* and a conical friction unit **164***b*, similar to the first rotator **154**, is rotatably installed in the lower portion of the subtray **130**. The gear **164***a* of the second rotator **164** is engaged with the rack **163***a* of the second tray **160**.

The friction unit **154***b* of the first rotator **154** and the friction unit **164***b* of the second rotator **164** are installed so that they face each other. The respective friction units **154***b* and **164***b* protrude slightly outside the subtray **130** through a sidewall of the subtray **130**.

Known disk recording/reproducing elements such as a turntable **141** for disk rotation and an optical pickup **142** for light beam emission are installed in the deck **140**. When the subtray **130** is lowered, the disk D2 seated in the disk seating unit **160** of the second tray **160** is transferred to and supported by the turntable **141** which protrudes slightly above the disk seating unit **161** when subtray **130** is in a fully lowered position. Referring to FIG. **7**, a clamp **145** is installed between the first tray **150** and second tray **160** of the subtray **130**. When the subtray **130** is lowered, the clamp **145** applies pressure to the top of the disk D2 supported on the turntable **141** to prevent wobbling of the disk D2.

As illustrated in FIG. **4**, a tray driving motor **180** is mounted on the inside of a sidewall of the housing **110**. A conical friction member **182** is fixed on the output shaft of the tray driving motor **180**. The friction member **182** selectively contacts the friction unit **154***b* of the first rotator **154** or friction unit **164***b* of the second rotator **164** according to the elevation state of subtray **130**.

A driving gear **181** is also disposed on the output shaft of the tray driving motor **180**. The driving gear **181** is engaged with a rotation cam plate **187** by a train of gears **184**, **185** and **186** interposed therebetween. A cam groove **187***a*, which spirals outward from a position near the center of rotation cam plate **187** to a periphery thereof, is formed in the rotation cam plate **187**. An upper protrusion **188***a* of a slide member **188**, which is movable forward and backward with respect to housing **110**, is received in the cam groove **187***a*. A lower protrusion **188***b* of the slide member **188** is connected to one end of a rotating member **189** which is rotatably installed on the bottom of the housing **110**. A coupling gear **191** is rotatably connected to the other end of the rotating member **189**. An elevating motor **190** is connected to the rotating member **189** and drives the coupling gear **191** relative to the rotating member **189**. The coupling gear **191** is engaged with a first connecting gear **124** or a second connecting gear **192** depending on the rotational position of the rotating member **189**.

The first connecting gear **124** is engaged with a gear **123** fixed at the bottom of the screw stock **122**. The first connecting gear **124** is selectively connected to the coupling gear **191** by the tray driving motor **180**, and the screw stock **122** engaged with the first connecting gear **124** by the gear **123**, constitute magazine elevating means for elevating the magazine **120** in combination with the elevating motor **190**.

The second connecting gear **192** is engaged with a gear **195***a* (see FIG. **8**) of a rack member **195** by a train of gears **193** and **194** interposed therebetween. The rack member **195** is slidably mounted for forward and backward movement with respect to the housing **110** along a rail **196** installed at the bottom of the housing **110**. A protrusion **195***b* is formed on one side of the rack member **195**. The protrusion **195***b* is slidably received in a diagonal cam groove **132** formed in the sidewall of the subtray **130**. This allows subtray **130** to move up and down as the rack member **195** moves forward and backward. The rack member **195** having the aforementioned configuration constitutes a subtray elevating means in combination with the coupling gear **191** and elevating motor **190**.

As illustrated in FIG. **2**, a pair of rollers **170** are installed between the subtray **130** and the magazine **120**, are spaced apart by a predetermined distance, and extend in parallel to one another. The rollers **170** constitute disk transferring means for transferring a disk from the magazine **120** to the disk seating unit **151**/**161** of either the first tray **150** or the second tray **160**, whichever is positioned at the height of the disk entrance **111** of the housing **110**, or to place a disk seated on the disk seating unit **151**/**161** of the tray into the magazine **120**. If the rollers **170** rotate after the disk is inserted therebetween, the disk is pressingly transferred from the subtray **130** to the magazine **120** by the friction force of the rollers **170**, or from the magazine **120** to the subtray **130**, depending on the direction of rotation of the rollers **170**.

In the raised state of subtray **130**, the first and second trays **150** and **160** are supported at a first position where the disks D1 and D2 in disk seating units **151** and **161** are spaced apart from the rollers **170** by a predetermined distance. During the lowering of the subtray **130**, the disk D2 seated in the disk seating unit **161** of the second tray **160** is placed on and supported by the turntable **141** of the deck **140**.

With the subtray **130** in a lowered state, the first tray **150** may be moved horizontally between the first position and a second position where the disk D1 seated in the disk seating unit **151** is inserted between the rollers **170** of the housing **110**, by a first tray position changing means having the locking rib **155**, the first rotator **154** with the coupling protrusion **154***c* connected to the locking rib **155** and the tray driving motor **180**. The first tray **150** may be locked at the first position or the second position depending on the rotational position of the first rotator **154**.

With the subtray **130** in a raised position, the second tray **160** may also be moved horizontally from the first position to a second position where the disk D2 seated in the disk seating unit **161** is inserted between the rollers **170** of the housing **110** forward and backward with respect to the housing **110**, or its position can be fixed at the first or second position. A second tray position changing means for horizontally moving second tray **160** between the first position and the second position is constituted of the locking rib **165**, the second rotator **164** with the coupling protrusion **164***c* connected to the locking rib **165** and the tray driving motor **180**. The second tray **160** may be locked at the first or second position in a manner similar to the first tray **150**.

The operation of the disk recording/reproducing apparatus having the aforementioned configuration will now be described.

First, as shown in FIGS. **3** and **7**, if the disk D2 seated in the disk seating unit **161** of the second tray **160** is to be recorded or reproduced, the subtray **130** must be moved to the lowered position. For this purpose, if the tray driving motor **180** is rotated in one direction, the driving gear **181** fixed on the output shaft of the tray driving motor **180** rotates, and the rotation cam plate **187** rotates by the train of gears **184**, **185** and **186** connected to the driving gear **181**. The slide member **188** whose upper protrusion **188***a* is locked into the snail cam groove **187***a* of the rotation cam plate **187** is transferred from the state depicted by the solid line to that depicted by the dashed line in FIG. **4** by the rotation of the rotating cam plate **187**. At this time, the rotating member **189** connected to the slide member **188** also rotates in the manner as depicted by the dashed line in FIG. **4**, and the coupling gear **191** rotatably connected to the end of the rotating member **189** is engaged with the second connecting gear **192**.

In such a state, if the elevating motor **190** rotates in one direction to rotate the coupling gear **191**, the rotational force is transferred to the rack member **195** via the train of gears **192**, **193** and **194**, so that the rack member **195** is transferred from the state shown in FIG. **2** to the front of the housing **110** along the rail **196**. In response to the movement of the rack member **195**, the protrusion **195***b* of the rack member **195**

slides along the diagonal cam groove **132** to lower the subtray **130** as shown in FIGS. **8** through **10**.

With the subtray **130** in the lowered position shown in FIGS. **9** and **10**, the first tray **150** is positioned at the height of the disk entrance **111** of the housing **110** and friction member **182** connected to the output shaft of the tray driving motor **180** makes contact with the friction unit **154***b* of the first rotator **154**. At this time, the gear **154***a* of the first rotator **154** is disengaged from the rack **153***a* of the first tray **150**, as shown in FIG. **12**. The coupling protrusion **154***c* of the first rotator **154** is positioned between the first wall **155***a* and the second wall **155***b* of the locking rib **155**. The disk D2 seated in the disk seating unit **161** of the second tray **160** is then transferred to and supported by the turntable **141** of the deck **140**. The turntable **141** can be rotated and the optical pickup **142** moved radially along the disk D2 to then record information onto or read information from the disk D2 in a known manner.

During recording or reproducing of the disk D2, the first tray **150** can be moved between a position where it protrudes outside the housing **110** via the disk entrance **111** as indicated by the dashed line of FIG. **10** and the second position shown in FIG. **11**. This movement can be accomplished as follows. First, as shown in FIG. **12**, in the state where the first tray **150** is located inside the housing **10** apart from the disk entrance **111** by a constant distance L1, if the tray driving motor **190** is operated so that the first rotator **154** rotates in the direction indicated by arrow A, the friction member **182** fixed on the output end of the tray driving motor **180** also rotates. At this time, the first rotator **154** closely contacting the rotating friction member **182** rotates by the frictional force between the friction unit **154***b* and the friction member **182**.

In response to the rotation of the first rotator **154**, the coupling protrusion **154***c* of the first rotator **154** which is inserted between the first wall **155***a* and second wall **155***b* in the lower portion of the first tray **150**, contacts fourth wall **155***d* while it rotates in the direction of arrow A, as shown in FIG. **13**. Then, in response to the continued rotation of the tray driving motor **180**, the coupling protrusion **154***c* presses against the fourth wall **155***d* to then move the first tray **150** away from the disk entrance **111** of the housing **110** by a predetermined distance L, as indicated by the dashed line of FIG. **14**. Accordingly, the position of the first tray **150** is positioned at the second position where the disk D1 seated in the disk seating unit **151** is inserted between the rollers **170**, as shown in FIG. **11**.

In the state where the first tray **150** is positioned at the second position, the coupling protrusion **154***c* of the first rotator **150** is inserted between the third wall **155***c* and fourth wall **155***d*. Then first tray **150** is fixed at the second position, with the back and forth movement of the housing **110** being prevented.

With the first tray **150** fixed at the second position as described above, the disk D1 seated on the disk seating unit **151** of the first tray **150** is inserted between the rollers **170**. As the rollers **170** rotate, the disk D1 is pressingly transferred toward the magazine **120** by the friction force of the rollers **170** and is received in a disk receiver positioned at the same height as that of the transferred disk among the disk receivers **121** of the magazine **120**.

After the magazine **120** is raised or lowered by an elevation process (to be described later), a disk of another disk receiver is extracted by a well-known disk extracting means such as an extracting lever (not shown) installed within the disk receiver, inserted between rollers **170** and then pressingly transferred toward the first tray **150**. The disk extracted from the magazine **120** and pressingly transferred by the rollers **170** is seated in the disk seating unit **151**. In this way, if the upper disk D1 of the first tray **150** is inserted between the rollers **170** by the movement of the first tray **150** to the second position, the need to install a separate extracting lever for inserting a disk on the tray between the rollers **170** is eliminated. This reduces costs in comparison to the conventional disk recording/reproducing apparatus which does not have a method of moving the tray to the above-described second position.

The first tray **150**, having received a new disk from the magazine **120** by the rollers **170** at the second position, moves back to the first position by the rotation of the coupling protrusion **154***c* of the first rotator **154** within the locking rib **155** in the lower portion of the first tray **150**. In other words, as depicted by the dashed line of FIG. **15**, in the state where the coupling protrusion **154***c* of the first rotator **154** is inserted between the third wall **155***c* and fourth wall **155***d* of the first tray **150** to fix the first tray **150** at the second position, the tray driving motor **180** operates so that the first rotator **154** rotates in the direction of arrow B. Accordingly, the coupling protrusion **154***c* rotates in the direction of arrow B and then makes contact with the first wall **155***a,* as depicted by the solid line of FIG. **15**. The continued rotation of the first rotator **154** causes the coupling protrusion **154***c* to press against the first wall **155***a* and reaches a position between the first wall **155***a* and second wall **155***b,* as depicted by the solid line of FIG. **16**. In the course of such operation, the first tray **150** is moved toward the disk entrance **111** of the housing **110** a predetermined distance L.

If the rotation of the tray driving motor **180** stops here, the rotation of the first rotator **154** and coupling protrusion **154***c* thereof also stop. Thus, the first tray **150** can be fixed at the first position by the coupling protrusion **154***c* inserted between the first wall **155***a* and second wall **155***b*. If the driving motor **180** continues to rotate from the position of the coupling protrusion **154***c* being between the first wall **155***a* and second wall **155***b,* the coupling protrusion **154***c* also continues to rotate in the direction of arrow B to exit the locking rib **155** and makes contact with the outside of the fourth wall **155***d* of the locking rib **155**, as depicted by the solid line of FIG. **17**. Then, the coupling protrusion **154***c* presses against the fourth wall **155***d* and moves the first tray **150** forward toward the disk entrance **111** of the housing **110**, as shown in FIG. **18**. In the course of the forward movement of the first tray **150**, the gear **154***a* of the first rotator **154** engages with the rack **153***a* of the first tray **150** and as the tray driving motor **180** continues to rotate, the first rotator **154** continues to rotate by the friction force between the friction unit **154***b* and friction member **182**. Accordingly, the first tray **150** continues to move toward, and eventually through, the disk entrance **111** by the gear **154***a* and rack **153***a,* as shown in FIG. **19**. With the first tray **150** protruding out of the housing **110**, the disk seated in disk seating unit **151** can be replaced by a new disk.

Thereafter, if tray driving motor **180** is rotated in the reverse direction, the first rotator **154** rotates in the direction of arrow A by the friction force between the friction member **182** and friction unit **154***b* of the first rotator **154**. The first tray **150** having the rack **153***a* coupled to the gear **154***a* of the first rotator **154** is again moved back inside the housing **110** until the teeth of the gear **154***a* of the first rotator **154** and rack **153***a* of the first tray **150** are no longer engaged, thereby positioning the first tray **150** at the first position, as depicted by the solid line of FIG. **20**.

Then, the tray driving motor **180** rotates until the protrusion **154***c* of the first rotator **154** is inserted between the first

wall **155***a* and second wall **155***b* of the first tray **150** by being rotated in the direction of arrow A, as shown in FIG. **12**. In the course of such operations, since the teeth of the gear **154***a* of first rotator **154** and rack **153***a* of first tray **150** are no longer engaged, the first tray **150** remains at the first position. If the rotation of the tray driving motor **180** stops when the protrusion **154***c* is inserted between the first wall **155***a* and second wall **155***b,* the first tray **150** will be fixed at the first position in spite of any external force applied to the first tray **150**, the backward and forward movement of the first tray **150** being prevented by the walls of the locking rib **155**.

Through the above-described procedure, a disk replacing operation, such that a disk stored in the magazine can be extracted and replaced by a new disk to be loaded in the disk receiver **121** within the magazine **120**, can be accomplished while another disk is recorded on or reproduced from.

The raising and lowering operation of the magazine **120** will now be described in this embodiment. First, the tray driving motor **180** is rotated in reverse to elevate the subtray **130**. At this time, the rotational force of the tray driving motor **180** is transferred to the rotation cam plate **187** via the driving gear **181** and the train of gears **184**, **185** and **186**, and the slide member **188** is moved by the upper protrusion **188***a* inserted into the cam groove **187***a* of the rotation cam plate **187**, as depicted by the solid line of FIG. **4**. Accordingly, the rotating member **189** moves in the state depicted by the solid line of FIG. **4**, as opposed to the operation of elevating the subtray **130**, and the coupling gear **191** rotatably connected to the end of the rotation member **189** is engaged with the first connecting gear **124**, as depicted by the solid line of FIG. **4**.

Then, when the elevating motor **190** coupled to the rotation member **189** is rotated to rotate the coupling gear **191**, the first connecting gear **124** and gear **123** connected thereto rotate and the screw stock **122** fixed on the gear **123** also rotates. The magazine **120** threadably engaged to the screw stock **122** is raised or lowered along the guide stock **122***a* according to the rotating direction of the screw stock **122**, i.e., the rotating direction of elevating the motor **190**.

As described above, while the disk D2 seated in the disk seating unit **161** of the second tray **160** is recorded on or reproduced from, the first tray **150** reciprocally moves between the first position and the second position or between the first position and the ejected position of the first tray **150** according to the rotation of the tray elevating motor **180**. Thus, during disk recording or reproduction, the replacement of a disk within the magazine **120** can be performed, that is, a disk accommodated in a predetermined disk receiver among the disk receivers **121** within the magazine **120** can be extracted and replaced by a new disk in the predetermined disk receiver.

If another disk within the magazine **120** is to be reproduced or recorded after the completion of the disk reproduction or recording, the disk D2 seated in the second tray **160** must be replaced with the other disk to be reproduced or recorded. For this purpose, tray driving motor **180** is operated to connect coupling gear **191** coupled to rotating member **189** with the second connecting gear **192** to then reverse the rotating direction of the elevating motor **190** for elevating the subtray **130**. Then, the rack member **195** returns to the back of the housing **110** through the train of the gears **192**, **193** and **194** and then the subtray **130** is lifted according to the movement of the rack member **195**.

With the subtray **130** lifted, the recorded/reproduced disk D2 on the turntable **141** is seated in the disk seating unit **161** of the second tray **160**, as shown in FIGS. **3** and **7**, and the second tray **160** at the first position is transferred to the height of the disk entrance **111** of the housing **110**. At this time, the friction member **182** coupled to the output shaft of the tray driving motor **180** makes contact with the friction unit **164***b* of the second rotator **164**. In such a state, if the tray driving motor **180** is rotated, the second rotator **164** rotates by the frictional force between the friction member **182** of the tray driving motor **180** and friction unit **164***b* of the second rotator **164**.

In the raised state of the subtray **130**, the second tray **160** is moved to the second position where the disk D2 seated in disk seating unit **161** is inserted between the rollers **170**, as depicted by the solid line of FIG. **21**. Here, since the second tray **160** has the locking rib **165** having the same configuration as that of the locking rib **155** of the first tray **150** and the coupling protrusion **164***c* having the same configuration as that of the coupling protrusion **154***c* of the first rotator **154**, as described earlier, the second tray **160** can be moved to the second position in the same manner as that of the first tray **150**.

Since the disk D2 of the second tray **160** which is moved to the second position is inserted between the rollers **170**, a new disk accommodated within the magazine **120** can be seated in the disk seating unit **161** of the second tray **160** in the same manner as the disk changing process of the first tray **150**, thereby completing the disk changing operation.

After the operation of changing disks of the second tray **160** is completed, second tray **160** returns to the first position. In such a state, if the subtray **130** is lowered, the new disk is supported on the turntable **141** to be reproduced from or recorded on.

As described above, the second tray **160** includes the rack **163***a* having the same configuration as that of the rack **153***a* of the first tray **150** and the second rotator **164** having the same configuration as that of the first rotator **154**. Also, the gear **164***a* of the second rotator **164** is engaged with the rack **163***a* of the second tray **160**. Thus, in the raised state of the subtray **130**, the second tray **160** may protrude to the outside of the housing **110** via the disk entrance **111** by the rotation of the tray driving motor **180** and a frictional force between the friction unit **164***b* of the second rotator **164** and the friction member **182**, as depicted by the dashed line of FIG. **21**. Therefore, when a disk is not being recorded on or reproduced from, a disk accommodated in any disk receiver among the disk receivers **121** of the magazine **120** can be replaced with a new one by the second tray **160**.

In the above-described embodiment, according to the rotating direction of the tray driving motor **180**, the coupling gear **191** rotatably coupled to the rotating member **189** is connected with the first connecting gear **124** or the second connecting gear **192** and the elevating motor **190** installed in the rotating member **189** is rotated to selectively elevate the subtray **130** or the magazine **120**.

However, in a second embodiment illustrated in FIG. **22**, the magazine **120** and the subtray **130** may be lifted independently. For instance, means for elevating the subtray **130** and means for elevating the magazine **120** may be constructed separately, as shown in FIG. **22**. In other words, the magazine elevating means is comprised of a first worm gear **123***a* fixed to the screw stock **122** and a first motor **129** fixed on the housing **110** and having a first worm **128** coupled to the first worm gear **123***a* at its output shaft. The subtray elevating means is comprised of an auxiliary screw stock **131***a* rotatably coupled to the housing **110** and screw-coupled to the subtray **130**, a second worm gear **131***b* fixed

to the auxiliary screw stock **131***a* and a second motor **139** fixed on the housing **110** and having a second worm **138** coupled to the second worm gear **131***b* at its output shaft.

In the second embodiment, when the first motor **129** rotates, the rotation force is transmitted to the screw stock **122** via the first worm **128** and the first worm gear **123***a* coupled thereto to rotate the screw stock **122**, thereby lifting or lowering the subtray **130**. Also, when the second motor **139** rotates, the rotation force is transmitted to the auxiliary screw stock **131***a* via the second worm **138** and second worm gear **131***b* coupled thereto to rotate the auxiliary screw stock **131***a*, thereby raising or lowering the subtray **130**. Accordingly, the subtray **130** and the magazine **120** can be raised or lowered independently.

A disk recording/reproducing apparatus according to a third embodiment of the present invention is schematically shown in FIGS. **23** and **24**. As shown in FIGS. **23** and **24**, in a disk recording/reproducing apparatus **100***a* according to this embodiment, a subtray **130***a* for supporting the first tray **150** and the second tray **160** for horizontal movement to the front and rear of a housing **110***a* is fixed to the housing **110***a* by means of supporting brackets **114**. A deck **140***a* in which a turntable **141** and an optical pickup **142** are installed is elevatably installed in the lower portion of the subtray **130***a*, by a motor **149** fixed to the bottom of the housing **110***a* and a screw stock **148** fixed on the output shaft of the motor **149** and screw-coupled to the deck **140***a*. Thus, the deck **140***a* approaches the subtray **130***a* as the deck **140***a* is lifted.

Disk entrances **111** and **112** are installed at the front wall of the housing **110***a* at heights corresponding to the first tray **150** and second tray **160**, respectively. A pair of rollers **171** and **172** are installed at the rears of the first tray **150** and second tray **160**, respectively. The pairs of rollers **171** and **172** have the same structure and function as those of the rollers **170** in the aforementioned embodiments. The magazine **120** for accommodating a plurality of disks is raised or lowered according to the rotation of the screw stock **122** via a worm **128** fixed on the output shaft of the motor **129** and a worm gear **123***a* coupled thereto, similar to the embodiment shown in FIG. **22**.

In the disk recording/reproducing apparatus **100***a* having the aforementioned configuration, the first tray **150** and second tray **160** are inserted into or ejected from the corresponding disk entrances **111** and **112** by a proper driving source (not shown) when the deck **140***a* is in a lowered state, as shown in FIG. **23**. The first tray **150** may be moved to the second position where the disk D1 seated thereon can be inserted between the upper rollers **171** by an appropriate driving means, e.g., the first rotator **154** or the coupling protrusion **155** in the above-described embodiments. Also, the second tray **160** may be moved to a second position where a disk D2 seated thereon can be inserted between the lower rollers **172**.

As shown in FIG. **24**, with the deck **140***a* raised by the rotation of the motor **149**, the turntable **141** protrudes above the second tray **160** to pick up and support the disk D2 seated on the disk seating unit **161**. While the turntable **141** rotates and an optical pickup **142** moves radially along the disk D2, information is recorded or reproduced. In this manner, even during recording/reproduction of a disk, disks in the magazine can be replaced by the same procedure as the disk exchanging procedure in the first and second embodiments, by the first tray **150** moving forward and backward with respect to the housing **110***a* from a position outside the housing **110***a* and a position at the upper rollers **171**.

In the disk recording/reproducing apparatus **100** described with reference to FIG. **2**, the rack **153***a* of the first tray **150** extends from the end of the guide **153** adjacent to the portion where the locking rib **155** is formed. When the first rotator **154** rotates, the first tray **150** is inserted into or extracted from the disk entrance **111** of the housing **110** and is movable to the second position by the engagement of the rack **153***a* with the gear **154***a* and the engagement of the locking rib **155** with the coupling protrusion **154***c*. Instead, the rack **153***a* beneath first tray **150** may be further extended to the front of the first tray **150** with only the gear **154***a* of the first rotator **154** engaged with the rack **153***a* of the first tray **150** without the engagement of the locking rib **155** with the coupling protrusion **154***c*, to then be moved to the second position and the position where the first tray **150** protrudes out of the disk entrance **111**.

Also, the second tray **160** may be moved to the second position and the position where the second tray **160** protrudes out of the disk entrance **111** only through the engagement of the gear **164***a* of the second rotator **164** with the rack **163***a* of the second tray **160** by further extending the rack **163***a* beneath the second tray **160** to the front of the second tray **160**, without the need for the coupling protrusion **164***c* of the second rotator **164** and locking rib **165** beneath the second tray **160**.

In the embodiments described above, the first tray **150** and second tray **160** are movably installed between the first position and the second position, for inserting disks seated on each disk seating unit between the rollers. However, as in conventional apparatuses, with the first and second trays fixed at the first position, a separate extracting lever may be installed between the first and second trays to insert a disk between the rollers.

Also, the second tray **160** may be installed on the subtray so that the second tray **160** does not protrude outside the housing, contrary to the above embodiments. Finally, the operation of the invention can be controlled by known control devices, such as a microprocessor programmed in a desired manner.

Although specific embodiments of the present invention have been described, it will be understood that various modifications may be made without departing from the scope of the present invention as defined by the appended claims.

What is claimed is:

1. A disk/recording reproducing apparatus comprising:

a housing having at least one disk entrance formed in a front wall thereof;

a magazine having a stack of disk receivers, said magazine being installed at a rear of said housing;

means for elevating and lowering said magazine;

a subtray and a deck each installed inside said housing between said disk entrance and said magazine;

means for moving said subtray and deck relatively toward and away from each other;

a first tray, having a first disk seating unit on an upper portion thereof, installed on said subtray;

first tray transferring means for transporting said first tray horizontally forward and backward with respect to said housing;

a first transferring means for placing a disk in said magazine onto said first disk seating unit and moving a disk from said first disk seating unit into said magazine;

a second tray, having a second disk seating unit on an upper portion thereof, supported by said subtray between said deck and said first tray;

a second tray transferring means for placing a disk in said magazine onto said second disk seating unit and moving a disk from said second disk seating unit into said magazine;

a turntable installed on said deck and extending to a position above said second seating unit when said subtray and said deck are moved toward each other by said moving means, so that said turntable raises the disk off of said second disk seating unit; and

an optical pickup installed on said deck;

wherein said first tray is positioned at the same height as said disk entrance so as to be insertable into/extractable from said disk entrance by said first tray transferring means while said deck records/reproduces information onto/from a disk on said second tray.

2. A disk/recording reproducing apparatus comprising:

a housing having at least one disk entrance formed in a front wall thereof;

a magazine having a stack of disk receivers, said magazine being installed at a rear of said housing;

means for elevating and lowering said magazine;

a subtray and a deck each installed inside said housing between said disk entrance and said magazine;

means for moving said subtray and deck relatively toward and away from each other;

a first tray, having a first disk seating unit on an upper portion thereof, installed on said subtray;

first tray transferring means for transporting said first tray horizontally forward and backward with respect to said housing;

a first transferring means for placing a disk in said magazine onto said first disk seating unit and moving a disk from said first disk seating unit into said magazine;

a second tray, having a second disk seating unit on an upper portion thereof, supported by said subtray between said deck and said first tray;

a second tray transferring means for placing a disk in said magazine onto said second disk seating unit and moving a disk from said second disk seating unit into said magazine;

a turntable installed on said deck and extending to a position above said second seating unit when said subtray and said deck are moved toward each other by said moving means, so that said turntable raises the disk off of said second disk seating unit; and

an optical pickup installed on said deck;

wherein said first tray is positioned at the same height as said disk entrance so as to be insertable into/extractable from said disk entrance by said first tray transferring means while said deck records/reproduces information onto/from a disk on said second tray; and

wherein said first transferring means comprises:

a pair of rollers installed between said magazine and said subtray; and

a first tray position changing means for horizontally moving said first tray between a first position where a disk on said first disk seating unit is separated from said pair of rollers and a second position where a disk on said first disk seating unit is inserted between said pair of rollers.

3. A disk recording/reproducing apparatus as claimed in claim **2**, wherein said first tray position changing means comprises a locking rib formed in said first tray, a first rotator rotatably installed on said subtray and having a coupling protrusion near its edge, and a driving source for rotating said first rotator, said locking rib comprising a first wall and a fourth wall disposed in parallel to each other and spaced apart from the front of said first tray, wherein the distance between said first wall and said fourth wall is smaller than the rotation diameter of said coupling protrusion, and wherein said coupling protrusion is selectively positioned between said first wall and said fourth wall, said first tray moves from said first position to said second position when said coupling protrusion presses against said fourth wall, and said first tray moves from said second position to said first position when said coupling protrusion presses against said first wall.

4. A disk recording/reproducing apparatus as claimed in claim **3**, further comprising means for locking the position of said first tray at said first position and said second position.

5. A disk recording/reproducing apparatus as claimed in claim **4**, wherein said first tray locking means includes a second wall and a third wall formed between said first wall and said fourth wall in parallel with each other, wherein said coupling protrusion is selectively inserted between said first wall and said second wall to limit the movement of said first tray when said first tray is positioned at said first position, and said coupling protrusion is selectively inserted between said third wall and said fourth wall to limit the movement of said first tray when said first tray is positioned at said second position.

6. A disk recording/reproducing apparatus as claimed in claim **2**, further comprising means for locking the position of said first tray at said first position and said second position.

* * * * *